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# Determination of Landfill Gas Composition and Pollutant Emission Rates at Fresh Kills Landfill

## Volume I

Project Report

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# DETERMINATION OF LANDFILL GAS COMPOSITION AND POLLUTANT EMISSION RATES AT FRESH KILLS LANDFILL

Revised Final Report

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## List of Acronyms and Abbreviations

| | |
|---|---|
| AAM | Ambient Air Monitoring |
| ACMM | Actual Cubic Meters per Minute |
| ASTM | American Society for Testing and Materials |
| CFM | Cubic Feet per Minute |
| $CH_4$ | Methane |
| $CO_2$ | Carbon Dioxide |
| CV | Coefficient of Variation |
| ELCD | Electrolytic Conductivity Detector |
| EPA | Environmental Protection Agency |
| FID | Flame Ionization Detector |
| FTIR | Fourier Transform Infrared Spectroscopy |
| GC | Gas Chromatography |
| GC/MD | Gas Chromatography with Multiple Detectors |
| GC/MS | Gas Chromatography with Mass Spectroscopy |
| GPS | Global Positioning System |
| Hg | Mercury |
| $H_2S$ | Hydrogen Sulfide |
| LCS | Laboratory Control Standard |
| LFG | Landfill Gas |
| MEK | Methyl Ethyl Ketone |
| mL | Milliliter(s) |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MSW | Municipal Solid Waste |
| NA | Not Applicable |
| NC | Not Calculated |
| NIST | National Institutes of Standards and Technology |
| NM | Not Measured |
| NYC DOS | New York City Department of Sanitation |
| OVA | Organic Vapor Analyzer |
| PID | Photoionization Detector |
| ppb | part(s) per billion |
| ppbV | part(s) per billion by volume |
| ppm | part(s) per million |
| ppmV | part(s) per million by volume |
| PSD | Particle Size Distribution |
| QAPP | Quality Assurance Project Plan |
| QA/QC | Quality Assurance/Quality Control |
| QC | Quality Control |
| RF | Response Factor |

## List of Acronyms and Abbreviations (Continued)

| | |
|---|---|
| RPD | Relative Percent Difference |
| RRT | Relative Retention Time |
| RT | Retention Time |
| TCD | Thermal Conductivity Detector |
| THC | Total Hydrocarbon |
| TNMHC | Total Non-methane Hydrocarbons |
| TNMOC | Total Non-methane Organic Compounds |
| TNR | Toluene Normalized Response |
| UHP | Ultra High Purity |
| U.S. EPA | United States Environmental Protection Agency |
| UTM | Universal Transverse Mercator |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compound |

## GLOSSARY

| | |
|---|---|
| Active Face | Area where new municipal solid waste (MSW) is added to the landfill and covered with soil cover. There are active faces on both Sections 6/7 and 1/9 where new MSW is placed in rows roughly 50m wide and 6m high on top of previously landfilled waste. |
| Activity Factor | A unit weight, volume, distance, or duration of activity that emits a pollutant. Activity factors are multiplied by emission factors to yield an estimated emission rate. Activity factors used in this report include the area of a given emission source (e.g., $m^2$ of emitting surface), the number of vents with measurable flow, and the mass of MSW present (e.g., kg of waste). |
| Detection Limit | Three standard deviations above average of seven replicate analyses of low-level standard, performed according to procedures given in 40 CFR 136, Appendix B. |
| Emission Factor | An average value which relates the quantity of a pollutant released to the atmosphere with the activity associated with the release of that pollutant. In most cases, these factors are simply averages of all available data of acceptable quality, without consideration of the influence of various process parameters such as temperature. Emission factors used in this report include the emissions per area of a given emission source (e.g., $\mu$g/min per $m^2$ of emitting surface), emissions per vent with measurable flow (e.g., g/sec per vent), and emissions as a function of the mass of MSW (e.g., g/sec per kg of waste). |
| Emission Flux | Emissions in terms of rate per area or, in other words, mass per time per area (e.g., $\mu$g/min-$m^2$). The emission flux multiplied by the total area of a given emission source yields the emission rate for that source. |
| Emission Rate | Emissions in terms of mass per time (e.g., g/sec). |
| Feature | Potential emission sources at the landfill, including passive vents, active face, cracks, seeps, perimeter vent trench, and the three parts of the outer surface of the mounds of waste: top, side, and toe. |
| Fixed Gas | Generally refers to gases that are present in the Earth's atmosphere in fixed concentrations: nitrogen, oxygen, methane, and carbon dioxide. In this report, fixed gases refer to these same compounds (e.g., analysis for fixed gases in vent samples), though their concentration within the landfill is not necessarily "fixed". |

## GLOSSARY (Cont.)

| | |
|---|---|
| Landfill Gas | All of the gas present within the landfill. This gas typically is approximately 50-60% methane, 40-50% carbon dioxide, and 1-2% all other trace gases. |
| Not Detected | No instrument Response. For GC-MD analysis of canister samples for VOCs, ≤250 area counts was the criteria for none detection. |
| PVC Cover | Polyvinyl chloride membrane used to cover landfill as part of closure activities. Additional soil is placed on top of the PVC cover and vegetation may be seeded to provide erosion control. |
| THC | Total hydrocarbons, including methane. |
| TNMHC | Total non-methane hydrocarbons, all volatile organic compounds present in a gas sample excluding methane. In this report, the TNMHC values are the sum of the FID response for all compounds reported as hexane (i.e., calculated using the hexane response factor and the molecular weight of hexane). |
| TNMOC | Total non-methane organic compounds. Equivalent to TNMHC. |

# METRIC CONVERSIONS

| Non-Metric Unit | Multiplied by | Yields Metric Unit |
|---|---|---|
| °F | 0.555556 (°F-32) | °C |
| in. | 2.54 | cm |
| ft. | 0.3048 | m |
| mile | 1609.344 | m |
| lb. | 0.453592 | kg |
| gal. | 3.78541 | L |
| mph | 0.44704 | m/sec |
| acre | 4,046.8564 | $m^2$ |
| acre | 0.404686 | hectare |

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# 1.0 INTRODUCTION

## 1.1 Background

The Fresh Kills Landfill is the largest landfill in the United States. In total, the landfill property covers approximately 1,200 hectares (3,000 acres) of Staten Island, a borough of the City of New York. The New York City Department of Sanitation (NYC DOS) operates the landfill and places there approximately 11,800 metric tons (13,000 tons) per day of municipal solid waste (MSW), six days a week, throughout the year. The landfill is located near residential and commercial areas of Staten Island. One major limited-access highway crosses the landfill, and other secondary roads extend onto the landfill property.

Citizens' interest groups and government agencies on Staten Island have requested that studies be conducted to determine the operating status and potential effects of the landfill on the surrounding communities. Of particular concern are air emissions from the landfill and their impact on local air quality. The landfill releases air emissions that may result in odors downwind of the facility and this has heightened community awareness of the landfill.

Air monitoring currently is being performed at the landfill. The New York State Department of Environmental Conservation operates an ambient air monitoring (AAM) network at the Fresh Kills landfill and collects samples every 6th day for volatile organic compounds (VOCs), particulate matter, and metals (NYDEC, 1995). Data are reported for roughly 20 individual VOCs; the sampling and analysis performed by the state is not intended to address all of the compounds that could be emitted from the landfill. AAM data can provide information about the air quality at the locations where monitoring occurs and, if the monitoring locations are selected properly, it can provide information about the maximum, or worst-case, ambient concentrations of pollutants in an area. AAM data by themselves, however, do not provide information about the amount of pollutants being released from the landfill or the locations where emissions are released, so the AAM data cannot be readily used to estimate the air quality further downwind within the community.

To evaluate air emissions from the landfill, the U.S. EPA Region II elected to perform a short-term intensive study to measure emissions of VOCs and other selected pollutants from the landfill and characterize the composition of the landfill gas. Radian Corporation, under EPA Contract No. 68-D3-0033, Work Assignment I-41, assisted the EPA in this effort. Hundreds of gas samples were collected at the landfill over a three week period in June and July of 1995, along with a limited number of soil and liquid samples. This report documents the findings of this measurement program.

## 1.2 Landfill Description

The general layout of the landfill is shown in Figure 1-1. The total area covered by landfilled municipal waste is 426.5 hectares (1,054 acres), and the mounds of waste extend up to 46 m (150 ft.) or more in height. The landfill is divided into four sections designated as 1/9, 6/7, 3/4, and 2/8.

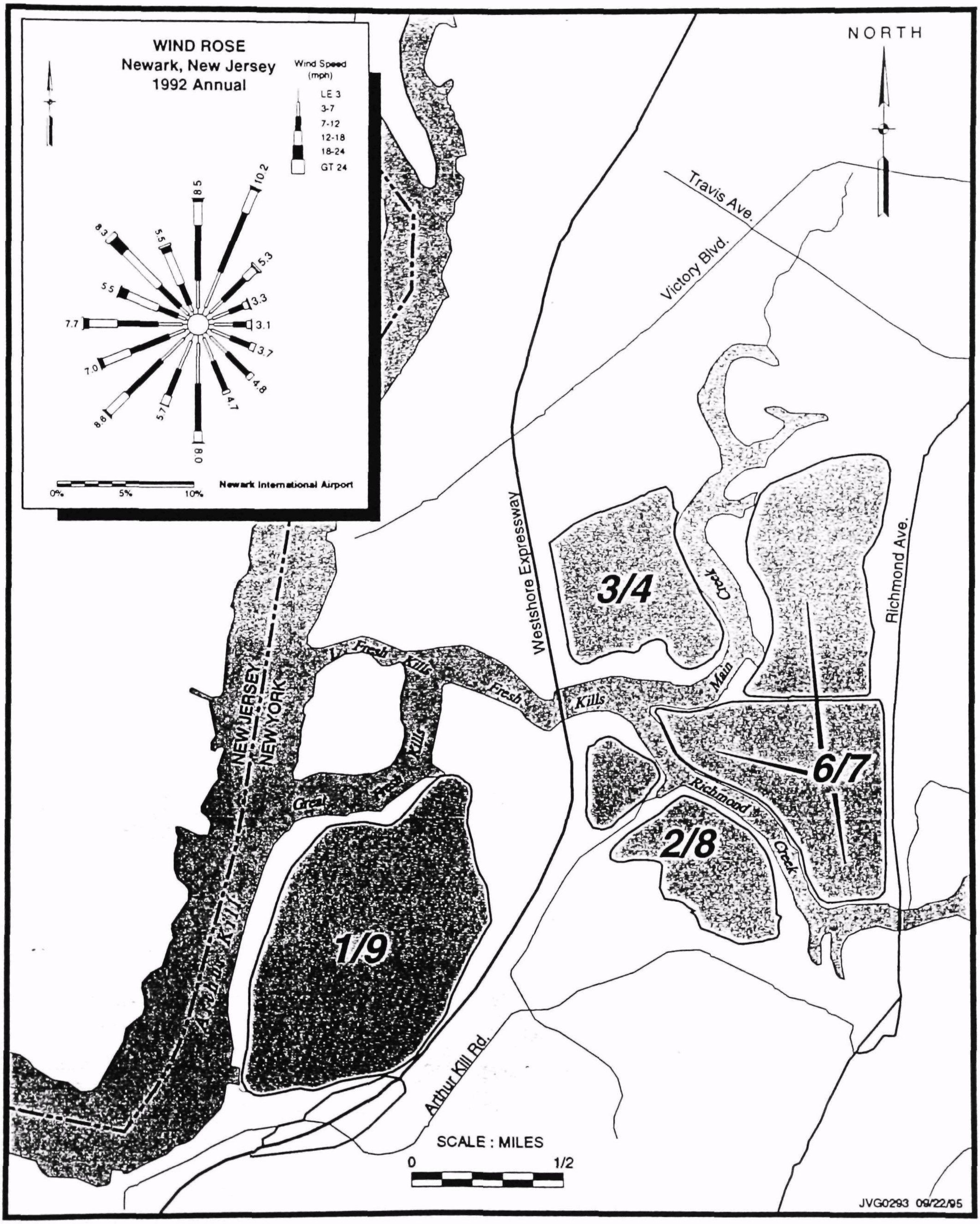


Figure 1-1. Schematic of General Landfill Layout

Sections 3/4 and 2/8 no longer accept trash; sections 6/7 and 1/9 are open and accept trash from all five boroughs of New York City. As shown in the wind rose in Figure 1-1, receptors located north, south, and east of the landfill may be impacted by air emissions from the landfill. The wind rose data are from the nearest National Weather Service station to Fresh Kills.

The landfill currently accepts primarily residential (household) garbage. Hazardous waste and medical waste are not currently placed in the landfill, nor are there any plans to allow them in the future. Some organic matter in the garbage, such as leaves and Christmas trees, is segregated and sent to a composting facility. The type of wastes and the composition of the wastes within each of the four sections are believed to be similar. Each of the four sections of the landfill is described below.

### 1.2.1 Section 3/4

The northwest portion of the Fresh Kills landfill is designated as Section 3/4 and covers approximately 57.2 hectares (141 acres). The waste in this section dates from when the section was opened in 1955 until it was closed in 1992. Section 3/4 is no longer accepting waste and currently is undergoing closure; i.e., being retrofitted with: 1) passive vents, 2) an impermeable PVC cover, and 3) a series of active gas collection wells. The passive vents in this and the other sections eventually will be plugged and the gas from the venting system will be combined with gas from the active gas collection wells. The collected gas will be processed and sold to a local utility.

Most (119) of the passive vents had already been installed at the time of the field sampling. Only those vents above the 42.7 m (140 ft.) elevation were not in place. The impermeable cap on the north, east, south, and west toe of this section consists of 0.30-0.46 m (12-18 in.) of compacted clay and covers approximately 9.1 hectares (22.5 acres). This portion of the cap was put in place between 1988 and 1990. The remaining 48.1 hectares (119 acres) of Section 3/4 are being capped with a PVC cover. This was approximately 17% complete at the time of sampling and the work is progressing at a rate of one acre/day. The PVC cover is being applied to the side slopes first, with the top receiving the PVC cover last.

The active gas collection system plan calls for the installation of 84 collection wells and a series of underground headers connecting the wells. To date, approximately 60 of the planned active gas collection wells have been installed throughout the landfill, however, the gas collection portion of the system has not been installed. The wells are 0.1 m (4 in.) in diameter and protrude above the landfill surface.

### 1.2.2 Section 2/8

The southeast portion of the Fresh Kills landfill is designated as Section 2/8 and comprises two distinct areas, which cover a total area of approximately 58.1 hectares (143 acres). The waste in this section dates from when the section was opened in 1948 until it was closed in 1993. Section 2/8 no longer accepts waste and currently is being retrofitted with: 1) passive vents, 2) an impermeable PVC cover, and 3) a series of active gas collection wells.

Most of the planned 113 passive vents have been installed (102 were installed at the time of our testing). The impermeable PVC cover on the north end of this section consists of 0.30-0.46 m (12-18 in.) of compacted clay and covers approximately 8.3 hectares (20.5 acres). This portion of the cap was installed in 1990. The remaining 49.8 hectares (123 acres) of Section 2/8 are being capped with a geomembrane, and this had been completed for approximately 7.3 hectares (18 acres) at the time of the field sampling program, with the work progressing at a rate of 0.4 hectare/day (one acre/day). The PVC cover is being applied to the side slopes first, with the top receiving the PVC cover last.

The active gas collection system plan calls for the installation of 48 collection wells and a series of underground headers connecting the wells. All of the planned active gas collection wells have been installed throughout the landfill, but the gas collection piping has not been connected to a gas recovery system.

### 1.2.3 Section 6/7

The northeast portion of the Fresh Kills Landfill is designated as Section 6/7 and covers approximately 136 hectares (336 acres). This section has been accepting waste since 1961 and the northern 75.4 hectares (186 acres) is currently active. There are no active gas collection wells, passive vents, or PVC cover at this section. The waste in this section is covered with 0.3-0.6 m (1-2 ft.) of intermediate cover (i.e., soil). The south portion of Section 6/7 contains the landfill's composting operations.

### 1.2.4 Section 1/9

The southwest section of the Fresh Kills Landfill covers approximately 176 hectares (435 acres) and is designated as Section 1/9. This section has been accepting waste since 1948 and is still active. This section has an active gas collection system which covers the southern 2/3 of this section. The gas collection system is operated by Air Products and produces about 400,000 $m^3$/day (14 million $ft^3$/day) of landfill gas. The landfill gas is routed to a gas processing plant adjacent to Section 1/9 where condensate, $CO_2$, and most VOCs are removed. The cleaned gas is sold to a local utility. This section contains three distinct regions: the area of the gas collection system, the closed area without landfill gas recovery, and the active landfill. There are approximately 36 passive vents in the southern portion of this section which are between 18 and 40 m (60 and 130 ft.) in elevation.

## 1.3 Project Objectives

The overall objectives of the program were to characterize the composition of landfill gas and determine the overall emission rate of various pollutants from the landfill. The specific objectives of this program were to:

- Collect samples of landfill gas from various locations and analyze the samples for a comprehensive list of target analytes;
- Measure the fluxes of landfill gas from the surface of each section of the landfill using an emission isolation flux chamber;

- Measure the flow and composition of landfill gas in the gas collection and passive venting systems; and
- Develop emission rate estimates for major features of the landfill and an overall emission rate estimate for the entire landfill.

## 1.4 Technical Approach

A general overview of the sampling approaches that were used is provided in Table 1-1. All four sections of the landfill were sampled to measure the emissions from each major emission source at the landfill, determine the heterogeneity of the emissions, and determine the composition of the gas below the surface within the landfill.

The emission estimates were produced by measuring emissions at the passive gas vents, as well as the soil flux of landfill gases at representative locations across the landfill. Measurements also were taken of samples from the landfill gas recovery system and landfill gas monitoring wells to characterize the composition of the gas below the surface within the landfill. Samples of the condensed liquid from the gas collection system also were collected, as were a limited number of samples of surface soils and liquid seeps from the landfill.

The emission estimates are based on:

- Flow rate and composition of gas released from the passive vent pipes;
- Flux rate and composition of gas released at the landfill surface; and
- Composition and flow rate of landfill gas and condensate from the gas collection system.

The limitations inherent in this study included logistical constraints on sample size. Spatial variability was considered to be the most important variable in this study related to representative sampling because landfills are known to exhibit a large variation in gas production from one area to the next. The focus of the sampling design therefore was to maximize the spatial coverage. Passive vents allow a "path of least resistance" for the landfill gases to escape the landfill, so the emissions from these sources were expected to be significantly higher (where they exist) than the emissions of landfill gases through the landfill surface. In areas without either passive vents or landfill gas collection, the landfill gases are emitted through the surface based on the subsurface obstructions and available natural pathways. The surface flux emissions were expected to be highly variable across the site, so the landfill surface areas were divided into features and each feature was initially screened to locate "hot spots" for placing flux chambers. The flux chamber measurements thus are conservative; i.e., they are biased such that they are higher than the average emission flux for a given area. The total number of flux chamber canisters were apportioned most heavily on landfill Section 6/7, which has no geomembrane, passive vents, or gas collection system and which is currently accepting waste.

The short-term temporal variability of the gas composition and emission rate also were evaluated. This study did not address long-term variability, but rather was intended to characterize emissions under the

## Table 1-1
## Summary of Sampling Approach

| Emission Source | Measured Parameter | On-Site Analysis | Off-Site Analysis |
|---|---|---|---|
| Passive vents | Gas flow | Flow rate and temperature | -- |
| | Gas composition | Fixed gases, Hg, $H_2S$ | VOCs, TNMOC, Fixed gases |
| Soil surfaces | Off-gas "hot spots" | THC | -- |
| | Off-gas flow | Flow rate (derived from flux chamber data) and temperature | -- |
| | Gas composition | $H_2S$ | VOCs, TNMOC, Fixed gases |
| | Soil physical properties | -- | % moisture, bulk density, particle density, PSD |
| | Soil composition | -- | VOCs |
| Landfill gas collection system | Gas flow | Flow rate and temperature | -- |
| | Gas composition | Fixed gases, Hg, $H_2S$ | VOCs, TNMOC, Fixed gases |
| | Liquid (condensate) composition | -- | VOCs |
| Surface seeps | Liquid composition | -- | VOCs |

| | | |
|---|---|---|
| Fixed gases | = | $CH_4$, $CO_2$, and $O_2$ |
| VOCs | = | Speciation for >100 compounds for canister samples, = EPA Method 8240 list plus other major chromatographic peaks for soil and liquid samples |
| TNMOC | = | Total non-methane organic compounds |
| THC | = | Total hydrocarbons |
| PSD | = | Particle size distribution |

current conditions (i.e., during the three weeks of testing in the summer of 1995). A statistical analysis of the measurement data was performed to characterize certain sources of variability. Sources of variability addressed in the sampling strategy included sampling, analytical, short-term temporal, and spatial components of variability. Diurnal variation from the passive vents was assessed from on-site measurements of flow, $H_2S$, and fixed gases made at the beginning and end of each sampling day.

The data from each individual measurement location were used to generate emission factors in terms of mass per time per area or per number of units or per mass of waste. For example, the measurements at the passive vents resulted in an emission factor of the average g/sec per vent for a given pollutant, while the measurements of the soil flux resulted in an emission factor of average g/sec per $m^2$ of emitting surface. These emission factors were multiplied by activity factors, such as the total number of vents or the total $m^2$ of emitting surface, to yield an emission rate in terms of mass/time.

## 1.5 Uses and Limitations of the Data

The purpose of this study was to measure air emission rates from the landfill and characterize the composition of the landfill gas. The data are valid for those purposes. The report provides information about the types of gas-phase pollutants both emitted and found within the landfill as well as the absolute amounts of various pollutants that are emitted. The report provides information about the relative strength of various emission sources; i.e., the percentage of the total emissions emitted from each section, from various landfill features, and from point versus area sources. Finally, the report provides information on the variability in the emissions.

Sections 2/8 and 3/4 of the landfill currently are undergoing closure and installation of a gas collection system, so the emission measurements made this summer are not necessarily representative of past or future emissions. Measurements were made only during summer months, and no attempt was made to determine the long-term variation in emissions from the various sources. Nevertheless, the emission factors developed in this study can be used to estimate past and future emissions at the landfill.

The activity factors may significantly change over time as the landfill undergoes closure and the physical layout of the Fresh Kills landfill changes, but the emission factors developed in this study should remain the best estimate of unit emissions; i.e., the number of vents may change or the amount of emitting soil surface may change, but the g/sec per vent or per $m^2$ of soil for a given feature (top, side, toe) and a given cover material (soil or liner) will remain unchanged over the next several years. This is true even if the passive vent gas ultimately is collected and routed to a gas plant. The amount of landfill gas produced per ton of waste is essentially constant over a several year period and, once produced, this gas will find a route to exit the landfill. Emission estimates can be made by updating the activity factor data and multiplying the updated activity factors by the emission factors given in this report. Over longer timeframes, (e.g. 5+years), the gas production rate will vary significantly as a function of the age of the waste and the emission factors in this report will be less reliable.

It was not the objective of this study to characterize the local air quality, determine the relative contribution of air emissions from the Fresh Kills landfill to the pollutant levels in the ambient air, or evaluate the impacts on human health and the environment of air emissions from the landfill. The data presented in this report do not directly address any of the above questions, but the data set generated in this study could be used to develop answers to those questions. For example, the emission rates, locations of emission sources, and release parameters (i.e., stack heights, flow rates, and temperatures) given in this report could be used as inputs to an atmospheric dispersion model to estimate short-term and long-term ambient concentrations at various locations within the community. These data then could be compared to existing regulatory and health standards as part of an air pathway assessment.

## 2.0 CONCLUSIONS AND RECOMMENDATIONS

A comprehensive landfill gas measurement program was performed over a 3-week period at the Fresh Kills landfill. Emission rates of landfill gases were determined from concentration and flow measurements made at the two major emission sources: passive vents and the surface of the landfill. In addition, the mass flow rates to the gas collection system at Section 1/9 were determined. Traditional sample collection and sample analysis methods were employed. Some consideration was given to using an open path monitoring approach employing Fourier Transform Infrared (FTIR) spectroscopy, but this approach was rejected due to concerns about the number of compounds that could be detected, the detection limits that could be achieved, and the difficulty in converting measured ambient concentrations to emission rates (Eklund, 1995).

The landfill contains four sections as shown in Figure 1-1 and each section can be subdivided into three features (top, side, and toe). The surface of the landfill is covered by either soil, clay, or a polyvinyl chloride (PVC) membrane. There are many possible combinations of features and cover material (e.g., top with soil cover, side with clay cover, etc.) The surface areas, number of passive vents, and other activity factors used to extrapolate the measured emissions to the entire landfill are summarized in Table 2-1 (all tables appear at the end of the section following the text).

The individual measurement data were compiled and evaluated to determine the typical composition of landfill gas at Fresh Kills. These data are shown in Table 2-2 for selected compounds. These compounds were selected based on their frequency of occurrence in the samples and their average concentration. The estimate is based on measurements made of the gas collection system. These represent integrated samples drawn from over 200 extraction wells that withdraw gas over a wide area and from a significant depth interval. The landfill gas composition was found to be fairly consistent from one emission source to another. Approximately 75 to 80% of the mass of VOCs in the samples was identified as specific VOCs.

The overall emission rates from the landfill were determined by summing the emissions from the passive vents and the emissions from the landfill surface. Of the two data sets, the emission rates for the passive vents are considered to be more accurate because volatile organic compound (VOC) measurements were made at about 25% of the vents. The emissions from the landfill surface, in contrast, are based on extrapolations from a limited number of measurements that cover only a small fraction of the total emitting surface.

For the surface emissions, emission factors were developed and emission rates were calculated based on surface areas. The surface area data were readily available and the surface area to volume ratio for the tops of the sections, where 90% of the surface emissions occur, was believed to be relatively constant across a given section. Similarly, the MSW density is assumed to be relatively constant across the landfill. Therefore, the surface area data were used as a surrogate for MSW mass. No attempt was made to correlate emissions to the age of the underlying waste.

The overall emission rates from the landfill for selected compounds are given in Table 2-3. An estimated 52.7 g/sec of total non-methane hydrocarbons (TNMHC) is being emitted. Emission rates for individual VOCs were up to 1.82 g/sec, with many VOCs in the 0.1 to 1.0 g/sec range. Hydrogen sulfide emissions are estimated to be 0.46 g/sec. An estimated 28,100 g/sec of methane is being emitted, along with 39,600 g/sec of carbon dioxide. The methane number is an upper limit based, in part, on the analytical detection limit of methane flux from surfaces covered by PVC cover. In general, the emission estimates are conservative (i.e., they are more likely to be biased high than biased low).

As a check of the emission rate estimates, the measurements from the gas collection system were used to develop emission rates for the entire landfill. The emission rates were developed by multiplying the total mass flow rate to the gas collection plant (north header + south header) by a factor of 9.1, which is based on the ratio of the total mass of MSW in the landfill to the mass of MSW within the area of influence of all gas extraction wells. The agreement between the two estimation approaches was better than expected.

The efficiency of the gas collection system was evaluated from the measured mass flow rates. The mass flow rate of methane to the gas collection plant is 2,090 g/sec. The measured methane emission flux from the surface of Section 1/9 in areas where active gas collection is taking place averaged 0.143 g/m$^2$-min over a surface area of 192,900 m$^2$. This flux equals an emission rate from the landfill surface of 460 g/sec of methane. Therefore, 82% of the landfill gas is being captured by the gas collection system.

Sections 2/8 and 3/4 of the landfill currently are being retrofitted with a PVC cover, passive vents, and extraction wells. Eventually the passive vents will be plugged and all collected gas will be routed to gas collection plants similar to the plant in operation at Section 1/9 (Gleason, 1995).

## 2.1 Conclusions

Several conclusions can be drawn from these data and the data presented elsewhere in this document:

- The measurement approaches used in this study were successful for the determination of emission rates and gas composition at the landfill;
- The emissions from the passive vents are relatively insignificant compared with emissions from the surface of the landfill on an absolute basis (due to the relatively small number of vents and the large amount of surface area);
- The gas extraction and collection system in place at Section 1/9 does a good job of controlling air emissions from the areas within the radius of influence of the gas extraction wells;
- The on-going retrofit of a PVC cover, passive vents, and extraction wells will ultimately result in reduced air emissions of VOCs from the landfill, once the gas is routed to a collection and processing system; and

- Measurements performed at the gas collection headers can be used to provide estimates of emissions from the overall landfill for many compounds, thereby providing reliable information in a very cost-effective manner.

## 2.2 Recommendations

The on-going retrofit of the landfill shows great promise for reducing air emissions. The completion of capping the landfill with a PVC cover, installing passive vents, and installing a facility-wide gas extraction and collection system would be beneficial from an air pollution standpoint.

A large and detailed data set was produced during this project and only certain key data trends and relationships were examined during the limited time available to review the data and produce this report. A more thorough analysis of the data is recommended before the data set is used for regulatory analysis and compliance issues, human health risk assessments, etc.

The mercury measurements were performed using a portable analyzer rather than the standard EPA reference method. In addition, mercury concentrations were measured at only a subset of the sampling locations. Therefore, the data set for mercury emissions generated in this study should not be considered to be definitive.

Several areas of work could help answer questions that still remain:

- Additional measurements of the mercury flux from the landfill surface would improve the existing knowledge of overall mercury emissions from the landfill;

- The anaerobic environment within the landfill is likely to result in some of the mercury being present as organo-mercury compounds. These compounds are generally more volatile and more toxic than elemental mercury. Speciation of the mercury emissions would provide useful information for any human health risk assessment work to be performed in the future.

- Measurements should be conducted at the gas processing plant to determine the fate of mercury entering the gas plant and the amount of mercury contained in the gas sold to the utility.

# Table 2-1
## Summary of Activity Factor Information

| Feature | Parameter | Units | Landfill Section | | | |
|---|---|---|---|---|---|---|
| | | | 1/9 | 6/7 | 3/4 | 2/8 |
| Passive Vents | Total count | # | 36 | 0 | 119 | 102 |
| Entire Section | Surface area | hectare | 175.57 | 75.44 | 57.17 | 58.05 |
| Entire Section | Mass of Waste | kg | $3.70 \times 10^{10}$ | $1.15 \times 10^{10}$ | $1.21 \times 10^{10}$ | $1.05 \times 10^{10}$ |
| "Top" of Section | Surface area | hectare | 68.95 | 39.52 | 13.02 | 11.77 |
| | Mass of Waste[c] | kg | $2.12 \times 10^{10}$ | $7.54 \times 10^{9}$ | $4.98 \times 10^{9}$ | $4.31 \times 10^{9}$ |
| "Side" of Section | Surface area | hectare | 56.24 | 20.31 | 22.10 | 21.70 |
| | Mass of Waste | kg | $8.16 \times 10^{9}$ | $2.70 \times 10^{9}$ | $4.92 \times 10^{9}$ | $4.23 \times 10^{9}$ |
| "Toe" of Section | Surface area | hectare | 30.02 | 13.33 | 22.05 | 24.58 |
| | Mass of Waste | kg | $1.70 \times 10^{9}$ | $1.27 \times 10^{9}$ | $2.16 \times 10^{9}$ | $1.97 \times 10^{9}$ |
| Active Face | Surface area | hectare | 1.07 | 2.28 | 0.0 | 0.0 |
| | Mass of Waste | kg | NA | NA | 0.0 | 0.0 |
| Landfill Gas Collection System | Surface Area | hectare | 19.29 | 0.0 | 0.0 | 0.0 |
| | Mass of Waste | kg | $7.82 \times 10^{9}$ | 0.0 | 0.0 | 0.0 |
| Cracks[a] | Surface area | $m^2$ | 1,756 | 754.4 | 571.7 | 580.5 |
| Seeps (wet) | Surface area | $m^2$ | 55.74 | 37.16 | 9.29 | 4.64 |
| Seeps (wet + dried)[b] | Surface area | $m^2$ | 55.74 | 37.16 | 9.29 | 4.64 |
| Perimeter Vent Trench[d] | Surface area | $m^2$ | 2,546 | 790 | 2,231 | 1,004 |
| Perimeter pipes | Total | # | 0 | 0 | 0 | 0 |

[a] Cracks were estimated to cover approximately 0.1% of entire surface area.
[b] Only wet seep areas were identified. Therefore, wet + dried seep area is set equal to wet seep area.
[c] Top of Section mass includes mass of active face which is located on the top of Section 1/9 and 6/7. Were unable to accurately measure mass of active face.
[d] Assumed width of vent trenches was 1.5 m (5 ft). Note: Vent trenches were not found during field investigation, but were found on autocad maps of each section.
NA = Not Available

# Table 2-2
# Average Landfill Gas Composition (ppm)

| Compound | Concentration (ppm) | Compound | Concentration (ppm) |
|---|---|---|---|
| Methane | 55.63% | o-Ethyltoluene | 3.43 |
| Carbon Dioxide | 37.14% | p-Diethylbenzene | 2.67 |
| Oxygen | 0.99% | m-Ethyltoluene | 2.49 |
| TNMHC | 438.09 | t-2-Pentene | 2.37 |
| Ethane | 222.61 | o-Xylene | 2.17 |
| Total Unidentified VOCs | 134.55 | o-Dichlorobenzene | 2.17 |
| Limonene | 35.38 | n-Propylbenzene | 2.09 |
| Toluene | 14.57 | Styrene | 2.02 |
| n-Decane & p-Dichlorobenzene | 13.97 | 1-Undecene | 2.02 |
| p-Isopropyltoluene | 13.14 | p-Ethyltoluene | 2.01 |
| Propane | 13.03 | 1,2,3-Trimethylbenzene | 1.90 |
| Isobutane | 8.24 | Benzyl Chloride & m-Dichlorobenzene | 1.88 |
| a-Pinene | 7.85 | 1,3,5-Trimethylbenzene | 1.76 |
| 3-Methylpentane | 7.75 | n-Butylbenzene | 1.50 |
| Acetone | 6.09 | m-Diethylbenzene | 1.46 |
| p-Xylene + m-Xylene | 5.97 | Dichlorodifluoromethane | 1.27 |
| n-Undecane | 5.50 | Chlorobenzene | 1.15 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 5.06 | Dichlorotoluene | 1.15 |
| Ethylbenzene | 4.71 | n-Octane | 0.99 |
| 1,3-Butadiene | 3.98 | n-Pentane | 0.97 |
| n-Butane | 3.80 | Benzene | 0.93 |
| Isopentane | 3.76 | n-Hexane | 0.92 |
| n-Nonane | 3.57 | Isobutene + 1-Butene | 0.92 |

Note: Values are given for all compounds detected above an average concentration of 0.90 ppm or greater in the landfill gas collection system headers. See Section 5 for complete data for all compounds.

# Table 2-3
# Landfill Gas Production and Emissin Rates for Fresh Kills Landfill

| Compound | Mass Emission Rates (g/sec) | | |
|---|---|---|---|
| | Emissions Captured by Landfill Gas Collection System[a] | Total Landfill Gas Production Rate[b] | Total Landfill Gas Air Emissions[c] |
| Carbon Dioxide | 3.83e+03 | 4.34e+04 | 3.96e+04 |
| Methane | 2.09e+03 | 2.39e+04 | 2.18e+04 |
| TNMHC | 8.02e+00 | 4.14e+01 | 3.34e+01 |
| Total Unidentified VOCs | 2.45e+00 | 1.71e+01 | 1.46e+01 |
| Ethane | 1.42e+00 | 3.24e+00 | 1.81e+00 |
| Isopentane | 5.01e-02 | 1.55e+00 | 1.50e+00 |
| n-Decane & p-Dichlorobenzene | 4.27e-01 | 1.87e+00 | 1.44e+00 |
| Isobutane | 1.03e-01 | 1.15e+00 | 1.05e+00 |
| Limonene | 1.03e+00 | 1.91e+00 | 8.82e-01 |
| Toluene | 2.94e-01 | 1.10e+00 | 8.02e-01 |
| Acetone | 8.74e-02 | 7.98e-01 | 7.10e-01 |
| n-Propylbenzene | 5.40e-02 | 7.34e-01 | 6.80e-01 |
| p/m-Xylene | 1.39e-01 | 7.59e-01 | 6.21e-01 |
| Ethylbenzene | 1.06e-01 | 7.00e-01 | 5.94e-01 |
| Propane | 1.25e-01 | 7.11e-01 | 5.85e-01 |
| 1,2,3-Trimethylbenzene | 4.75e-02 | 6.27e-01 | 5.79e-01 |
| n-Butane | 4.70e-02 | 6.01e-01 | 5.54e-01 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 1.34e-01 | 6.29e-01 | 4.96e-01 |
| n-Nonane | 1.00e-01 | 5.81e-01 | 4.81e-01 |
| Hydrogen Sulfide | 6.51e-01 | 1.10e+00 | 4.53e-01 |
| Methylene Chloride | 9.14e-03 | 3.09e-01 | 3.00e-01 |
| a-Pinene & Benzaldehyde | 2.33e-01 | 2.95e-01 | 2.95e-01 |
| o-Xylene | 4.99e-02 | 2.98e-01 | 2.48e-01 |
| 1,1-Dichloroethane | 9.33e-03 | 2.25e-01 | 2.16e-01 |
| Styrene | 4.70e-02 | 2.59e-01 | 2.12e-01 |
| Chlorobenzene | 2.88e-02 | 1.88e-01 | 1.59e-01 |
| Benzyl Chloride & m-Dichlorobenzene | 5.38e-02 | 1.68e-01 | 1.14e-01 |
| Tetrachloroethylene | 2.20e-02 | 1.31e-01 | 1.09e-01 |

**Table 2-3**
**(Continued)**

| Compound | Mass Emission Rates (g/sec) | | |
|---|---|---|---|
| | Emissions Captured by Landfill Gas Collection System[a] | Total Landfill Gas Production Rate[b] | Total Landfill Gas Air Emissions[c] |
| b-Pinene | 1.79e-02 | 1.06e-01 | 8.85e-02 |
| Vinyl Chloride | 3.88e-03 | 5.39e-02 | 5.00e-02 |
| Benzene | 1.60e-02 | 5.97e-02 | 4.37e-02 |
| 1,1,1-Trichloroethane | 5.02e-03 | 4.85e-02 | 4.35e-02 |
| c-1,2-Dichloroethylene | 1.20e-02 | 5.18e-02 | 3.97e-02 |
| Trichloroethylene | 0.00e+00 | 3.61e-02 | 3.61e-02 |
| 1,2,4-Trichlorobenzene | 3.28e-02 | 5.02e-02 | 1.74e-02 |
| Trichloroethene | 7.12e-03 | 1.41e-02 | 6.98e-03 |
| Mercury | 2.84e-02 | 3.38e-02 | 5.45e-03 |

[a] Emission to Landfill Gas Collection System include emissions from landfill gas condensate collected.
[b] Total landfill gas production = emissions from landfill surface + emissions from passive vents + emissions captured by landfill gas collection system.
[c] Total landfill gas air emissions = emissions from landfill surface + emissions from passive vents. Emissions captured by landfill gas collection system are incinerated.

## 3.0 TECHNICAL APPROACH

This section describes the technical approach employed during the Fresh Kills landfill gas characterization study. The monitoring program consisted of measuring the composition, concentrations, and flow rate of the landfill gas exiting the landfill (both passive vents and active landfill gas extraction being performed by Air Products) as well as collecting emission flux samples of the gas being emitted through the landfill surface. In addition, condensate samples from the landfill gas collection system, samples of the liquid (mud) coming from seeps at the landfill, and soil samples from the surface of the landfill were collected. Table 3-1 presents an overview of the sampling and analytical approaches used during the monitoring program.

A more detailed description of the project objectives, experimental design, sampling and analytical methods, and quality assurance and quality control procedures were presented in the Quality Assurance Project Plan/Sampling Plan for this project (Anderson, Burrows, and Eklund, 1995).

### 3.1 Sampling Strategy

This section briefly discusses the sampling strategy used during the monitoring program. Gas samples from three distinct sources of the landfill were collected:

- Sampling of the passive vent system;
- Flux chamber sampling of the soil emissions; and
- Sampling of the landfill gas collection system (both individual gas extraction wells and combined headers).

The site contains a number of passive vents, which are goose necked pipes open to the ambient air. These vents are used to provide "pathways of least resistance" of the landfill gas near the surface to avoid large gas pockets from building up under the landfill cover (liner). These vents were monitored for flow rate, fixed gases (i.e., $CH_4$, $CO_2$, and $O_2$), $H_2S$, mercury, and speciated hydrocarbons. Only three of the four landfill sections (3/4, 2/8, and 1/9) had passive vents installed, and those on 1/9 only covered a small portion of the section.

The gaseous emissions emanating from the landfill surface were measured using an emission isolation flux chamber (flux chamber). Fixed gases, $H_2S$, and speciated hydrocarbons were measured in air samples collected from the flux chambers. Mercury measurements were made at five locations. Flux measurements were made on all four sections of the landfill, however, the majority of the monitoring was performed on section 6/7. This section does not have an impermeable liner, passive vents, or a gas collection system, therefore it was expected to have the highest soil emissions from the soil surface. Limited numbers of flux measurements were made on the other three landfill sections, so that overall releases of landfill gas pollutants from the site could be estimated.

The third sample type was gas samples taken from the landfill gas collection system. Air Products is

# Table 3-1
# Summary of Sampling and Analytical Techniques

| Measurement | Sampling Technique | Analytical Technique |
|---|---|---|
| **Passive Vents** | | |
| Flow Rate | Direct Reading | Vane Anemometer |
| Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$) | Direct Reading | Geo Group GA90 Infrared Analyzer |
| Hydrogen Sulfide | Tedlar Bag | Jerome Model 631 $H_2S$ Analyzer |
| Mercury | Gold Foil Dosimeter | Jerome Model 431 Analyzer |
| Speciated VOCs, Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$), and TNMOC | SUMMA® Canisters | GC/MD (fixed loop) for speciated VOCs and TNMOC and TCD (fixed gas) |
| **Flux Chamber Monitoring of Emissions from Landfill Surface** | | |
| Hydrogen Sulfide | Tedlar Bag | Jerome Model 631 $H_2S$ Analyzer |
| Mercury | Tedlar Bag | Jerome Model 431 Analyzer |
| Speciated VOCs, Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$), and TNMOC | SUMMA® Canisters | GC/MD (fixed loop) for speciated VOCs and TNMOC and TCD (fixed gas) |
| **Surface Soil/Liquid Samples** | | |
| Speciated VOCs | Grab | SW-846 Method 8240 |
| **Individual Extraction Wells** | | |
| Flow Rate | Orifice Plate | Orifice Plate Calculation |
| Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$) | Direct Reading | Geo Group 6A90 Infrared Analyzer |
| Hydrogen Sulfide | Tedlar Bag | Jerome Model 631 $H_2S$ Analyzer |
| Mercury | Tedlar Bag | Jerome Model 431 Hg Analyzer |
| Speciated VOCs, Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$), and TNMOC | SUMMA® Canisters | GC/MD (fixed loop) for speciated VOCs and TNMOC and TCD (fixed gas) |
| **Combined Landfill Gas Recovery Headers** | | |
| Flow Rate | Standard Pitot | Pitot Calculation |
| Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$) | Direct Reading | Geo Group 6A90 Infrared Analyzer |
| Hydrogen Sulfide | Tedlar Bag | Jerome Model 631 $H_2S$ Analyzer |
| Mercury | Tedlar Bag | Jerome Model 431 Hg Analyzer |
| Speciated VOCs, Fixed Gases (i.e., $CH_4$, $CO_2$, and $O_2$), and TNMOC | SUMMA® Canisters | GC/MD (fixed loop) for speciated VOCs and TNMOC and TCD (fixed gas) |
| VOCs in Condensate | Grab | SW-846 Method 8240 |

collecting landfill gas from approximately two-thirds of Section 1/9, treating the gas to remove impurities, and selling the product gas.

This system is made up of over 250 individual extraction wells manifolded together. Samples were collected from the combined flow entering the gas plant as well as from individual wells. Over a third of these individual wells, however, were underground, making access to them impossible. Therefore, the wells that were sampled were selected from those above ground. All individual wells were manifolded into two well headers designated North or South field. Each of the two headers was 0.46m (18 in.) diameter and combined they carried approximated 350 $m^3$/min (10,000 CFM) of landfill gas. These two well field headers were sampled six times during the monitoring program. These data were used to determine the representative landfill gas composition, the mass flow rate and short term temporal variability in the landfill gas composition.

A major objective of the monitoring program was to assess the components and degree of variability for the data set. Potential sources of variability include:

- Sampling variability;
- Analytical variability;
- Temporal variability; and
- Spatial variability.

The monitoring program was designed to assess each of these various sources of variability.

In order to collect representative samples, the sampling and analytical methods must be reproducible. To measure the ability of the sampling and analytical method to accurately reproduce the measurement results, duplicate samples for each measurement technique were collected and those samples were then analyzed in duplicate (nested duplicates); i.e., for certain locations, two samples were collected and a total of four analyses were performed. This type of a design allowed the sampling and analytical variability to be estimated. The magnitude of these two components must be known before other components of variability can be assessed.

Temporal variability defines the degree to which a measurement varies over a period of time. This time period may be within the same day (diurnal), between different days, or over an annual period. Since this program only lasted three weeks, changes in concentration or mass emission rate due to temperature or seasonal changes could not be assessed. The design did evaluate the degree of variability of concentrations and emission rates over the period of the study. This was accomplished by sampling individual passive vents, extraction wells, and flux chamber locations multiple times over the course of the field study. The sampling and analytical duplicate samples were also collected as part of the temporal assessment.

Spatial variability defines the degree to which a measurement varies over area or space. This component is used to assess the degree of uniformity (or non-uniformity) in emissions from a given area. It is assumed that the general types of MSW accepted by all four sections of the landfill are similar, however, the exact composition of MSW buried at any given location may vary widely. Therefore, the overall emissions (both qualitatively and quantitatively) from a given landfill section would be expected to be fairly similar given equal areas, volume, and age. The emissions from point to point, however, could vary significantly. The spatial variability was assessed by sampling many different points from each section (or in the case of the passive vents, all locations). The spatial variability estimate also considers the differences in cover (e.g., liner, clay cap, or soil cover), feature (e.g., top, sides, or toe of landfill), and control devices (e.g., passive vents or landfill gas collection).

## 3.2 Sampling Procedures

This section describes the sampling approaches that were used to collect the various samples. This discussion is organized by type of sampling location (i.e., passive vents, flux chamber, and landfill gas collection system) with the various sampling techniques for each analyte described therein.

### 3.2.1 Passive Vent Gas Sampling

Landfill Sections 2/8, 3/4, and 1/9 have numerous passive vents that allow landfill gas to escape from the landfill. Every vent in these three landfill sections was sampled to determine the flow rate, the concentration of fixed gases (i.e., $CH_4$, $CO_2$, and $O_2$), and the concentration of $H_2S$. In addition, a subset of these vents were sampled for vapor phase mercury, TNMOC, and speciated VOCs. Section 2/8 contained 102 vents, Section 3/4 contained 119 vents, and Section 1/9 contained 36 vents. Approximately 10% of the vents did not have flow, so their location was noted, but no concentration data were collected.

Temporal and diurnal variability were evaluated by monitoring five vents over several days. These vents were sampled three times during the program for flow rate, $H_2S$, and landfill gases. During one of the sampling days, the vents were sampled morning and afternoon to help assess the extent of diurnal variability. Four of these vents were sampled for speciated VOCs using SUMMA® canisters. The VOC sampling (which included speciated VOCs, TNMOC, and fixed gases) also occurred on three occasions during the program. A duplicate canister was collected at each of the four vents. The duplicate canisters were analyzed in duplicate to allow for a "nested" statistical design. A detailed description of the sampling scheme used during the monitoring program was described in the QAPP/Sampling Plan.

The passive vent flow rates were determined using a 0.10m (4 in.) diameter vane anemometer. The anemometer was integrated into a section of tubing that attached directly to each passive vent, thereby forcing all gas exiting the vent to pass though the vane anemometer so that the total linear feet of landfill gas flow was measured. The period of time that gas was allowed to flow through the anemometer was measured so that the total linear feet of gas per unit time could be calculated. Since the cross-sectional area of the anemometer was known, the volumetric flow rate ($m^3$/min) could subsequently be calculated. The temperature of the gas exiting each vent also was measured.

The concentration of the fixed gases (i.e., $CH_4$, $CO_2$, and $O_2$) was determined using a hand-held direct reading instrument manufactured by Geo Group. This instrument has an internal sampling pump and measures the analyte concentrations using infrared spectroscopy. To determine the gas concentrations, a stainless steel probe was inserted at least 50 cm inside each vent and the analyzer was allowed to sample the vent gas until a steady value was displayed on the instrument. This value was then recorded.

The $H_2S$ concentrations were determined using a Jerome model 631 $H_2S$ analyzer. This is a real-time analyzer capable of monitoring $H_2S$ concentrations from the 3 ppb to 50 ppm range. With the addition of a dilution system, the upper range of the analyzer was increased to approximately 350 ppm. Samples were collected from each vent in one-liter Tedlar® bags and analyzed in the on-site laboratory. Tedlar® bag samples were transported to the laboratory approximately every hour so that analysis could be completed within four hours. Samples were allowed to equilibrate to the laboratory temperature prior to analysis.

Mercury samples from the passive vents were collected with Jerome gold-film dosimeters and analyzed using a Jerome Model 431 mercury analyzer. A teflon sampling probe was placed approximately 50 cm inside each vent, and sample gas was pulled at 100 mL/minute through the gold dosimeter for approximately one hour. A Dupont personal sampling pump, located downstream of the dosimeter, was used to control the flow through the dosimeter, while a calibrated rotameter was used to monitor the flow. Following sample collection, the samples were analyzed on-site using the Jerome mercury analyzer. All samples were analyzed within four hours of collection.

The canister samples were collected by inserting a teflon line about 50 cm into each vent and using the canister vacuum to collect the gas sample. Prior to sample collection, the sample line was purged with a hand-held pump. The canisters were not completely filled and were kept under vacuum (e.g., 6-10 inches Hg) to help prevent condensation inside the canister from the saturated gas stream and to allow greater dilutions to be made in the laboratory.

### 3.2.2 Flux Chamber Monitoring

The concentration of landfill gas being emitted from the surface of the landfill was estimated using the emission isolation flux chamber (flux chamber). The flux chamber is an enclosure device used to sample gaseous emissions from a defined surface area. The flux chamber method is an accepted standard EPA sampling method (Kienbusch, 1986) which has previously been used for measuring VOC emission rates from a variety of solid and liquid sources (Eklund, 1992).

The flux chamber was used to measure emission fluxes (mass/time per area) of individual VOCs, $H_2S$, and fixed gases. These data are used as inputs to develop an overall landfill emission rate (mass/time) for each area. All four landfill sections were characterized. Sections 2/8 and 3/4 are undergoing closure with geo-textile liners and passive vents. The strategy for these two sections was to sample points located over the liner, the clay cap, and the unlined/uncapped section, and to collect samples over various features (i.e., the top, sides, and toe) of the section. A total of ten points were sampled in each of these two sections.

Section 1/9 has an active face and contains a landfill gas recovery system that covers approximately two thirds of this section. This section contains three distinct regions: the area under the landfill gas recovery, the closed area without landfill gas recovery, and the active landfill. The sampling over this section was designed primarily to confirm that flux emissions were low where landfill gas was being recovered. A total of 10 flux chamber samples were collected from this section.

Section 6/7 has no cover, no passive vents, and no landfill gas collection system. In addition, this section also has an active face. Because there are no other ready pathways for the gas to exit the landfill, the gas generated in this section will tend to exit the soil surface, primarily through cracks and fissures in the landfill. Flux measurements were made at a total of 43 locations in this section.

In Section 6/7 sampling was conducted so that the three major features (i.e., tops, sides, and toes of the Section) could be characterized. This more intensive sampling of Section 6/7 was used to determine how emission rates are affected on the basis of geometry and construction of the landfill features. In addition, three flux measurements were made on "fresh" garbage areas of Section 6/7 (i.e., that portion where garbage has been covered less than one week). Flux samples were also collected where other significant landfill features, such as cracks and seeps were identified. As a quality control check and to assess short-term temporal variability, four sampling points were sampled three to four times during the study.

On a land surface this large, completely surveying the entire area was not feasible. Therefore, the strategy used to locate the flux points consisted of going to at least two widely-separated areas of the Section and using an OVA to survey emissions. The strategy was to locate "hot-spots" for flux chamber sampling on the top, sides, and toe of each area. This strategy was considered a conservative approach for estimating these surface emissions and therefore, should tend to bias the emission estimates high. While there may be locations of high emissions that were not sampled, this approach should result in the average of the measured values exceeding the actual average. The bias should be much less at the other sections where passive vents and gas collection are present.

The flux chambers were placed directly over the area to be monitored and pressed into the soil to a depth of 2-4 cm. Sweep air (helium) was initiated (approximately 10 L/min) using the sweep air regulator and the sweep air rotameter. The flux chamber was equilibrated, and after four chamber residence times (12 minutes), a short length of teflon tubing was connected to the flux chamber and the samples collected (either canister or bags samples).

Emission rates determined from the flux chamber sampling were calculated based on the flow rate of gases exiting the flux chamber ($F_E$: $m^3$/min), the concentration of each compound in the exiting gases ($C_E$: micrograms/$m^3$), and the flux chamber surface area (0.13 $m^2$), using the following equation:

$$\text{Emission Flux } (\mu g/m^2\text{-min}) = \frac{F_E * C_E}{0.13 \ m^2} \qquad \textbf{(Eq. 3-1)}$$

Figure 3-1 depicts the relationship of compound mass and landfill gas flow rates entering and exiting the flux chamber at steady-state conditions (i.e., the compound mass and volumetric flow rates into the chamber equals those exiting the chamber). The formulas for calculating the mass balance and the flow balance are:

**Mass Balance**

$$F_S * C_S + F_L * C_L = F_E * C_E \quad \textbf{(Eq. 3-2)}$$

**Flow Balance**

$$F_E = F_L + F_S \quad \textbf{(Eq. 3-3)}$$

where:

| | | |
|---|---|---|
| $F_S$ | = | Flow rate of sweep air; |
| $F_L$ | = | Flow rate of landfill gas; |
| $F_E$ | = | Flow rate of flux chamber exhaust; etc. |
| $C_S$ | = | Concentration of sweep air; |
| $C_L$ | = | Concentration of landfill gas; and |
| $C_E$ | = | Concentration of flux chamber exhaust. |

Since the sweep air used was ultra high-purity helium, the concentration of target compounds in the sweep air, $C_S$, is zero. Substituting for $F_E$ in the first equation and rearranging yields the landfill gas flow rate into the chamber:

$$F_L = \frac{F_S * C_E}{C_L - C_E} \quad \textbf{(Eq. 3-4)}$$

This equation, along with the sweep air flow rate, can be used to calculate the flux chamber exhaust flow rate, $F_E$. In most instances, the landfill gas flow rate ($F_L$) is much less than the sweep air flow rate ($F_S$), so the flux chamber exhaust flow rate ($F_E$) is essentially equal to the sweep air flow rate ($F_S$). Several of the points sampled, however, had significant gas flow to the surface. Therefore, to calculate the landfill gas flow rate ($F_L$) for these points, the methane concentration in the landfill gas ($C_L$) was assumed to be 50%. This value was based on methane concentrations found in the landfill gas extraction wells and passive vents (i.e., raw landfill gas). This value was then substituted into equation 3-4 to determine $F_L$.

### 3.2.3 Landfill Gas Recovery System Sample Collection

The landfill gas (LFG) recovery system was sampled for gas flow rate, $H_2S$, mercury, fixed gases ($CH_4$, $CO_2$, and $O_2$), and speciated VOCs. The well field headers (north field and south field) were monitored just prior to entering the gas plant. In addition, 25 individual gas extraction wells were sampled. The 25 individual extraction wells were sampled to assess spatial variability of landfill gas composition and concentration. A number of the individual extraction wells were underground and manifolded together, making the sampling of certain individual wells impossible. As many as two dozen of these wells were manifolded together. Because sampling these headers provided an integrated sample

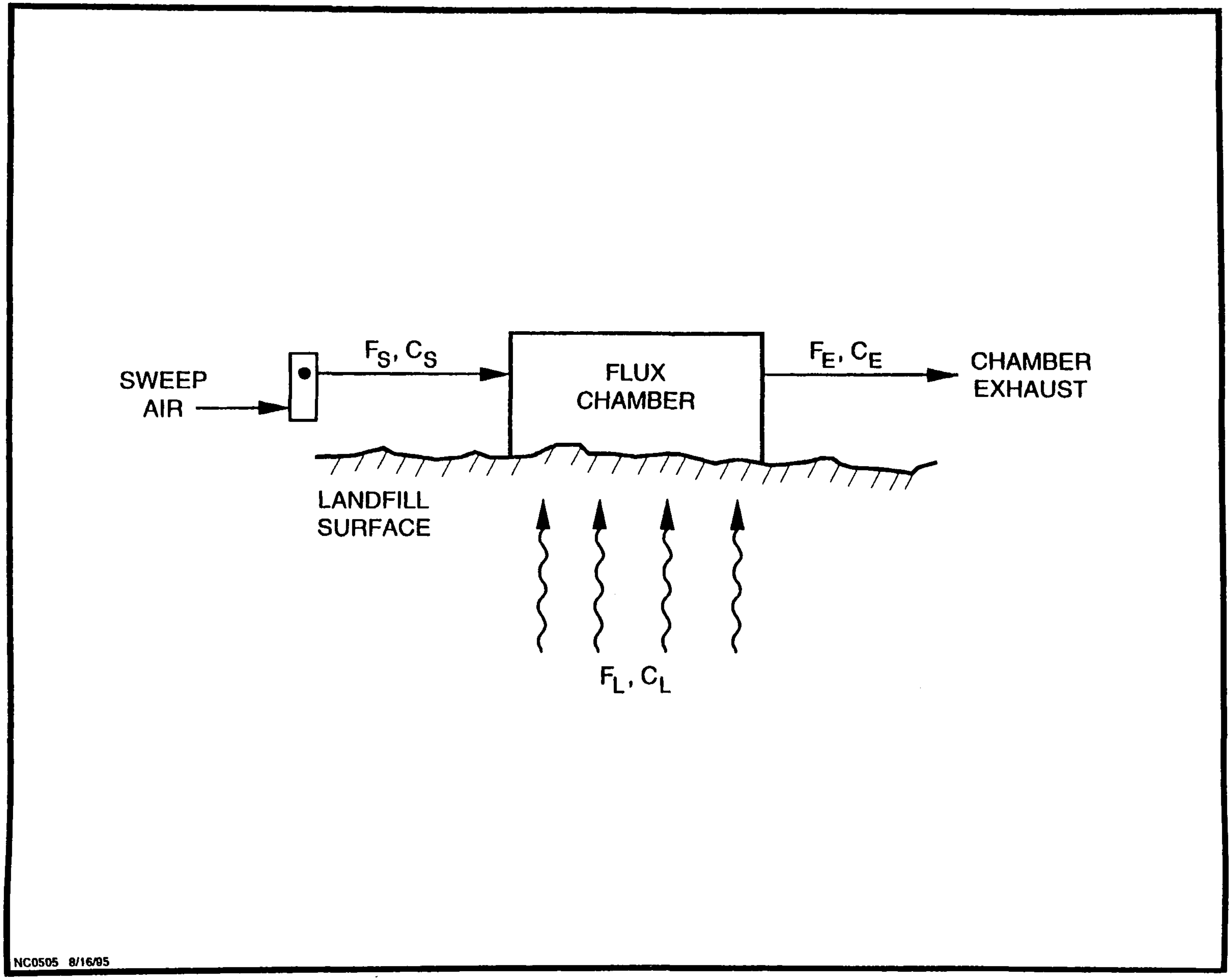


**Figure 3-1 Mass and Flow Rates Entering and Exiting the Flux Chamber**

representing all wells, no attempt was made to try to characterize individual lines.

The gas flow rate of the landfill gas collection system was determined using standard pitot tubes installed in the two header lines. The individual well flow rates were determined using an orifice plate installed in the system between the well head and the vacuum line. The pressure drop across the orifice plate or pitot tube, the duct diameter, gas moisture content (assumed to be at saturation), orifice plate calibration factor, and gas molecular weight were used to determine the volumetric flow rate.

Fixed gases, $H_2S$, and mercury samples were collected in Tedlar® bags and analyzed in the on-site laboratory. Gas was extracted from the wells and well headers using a vacuum pump. The analysis technique used for these samples was the same as those used for the passive vents, except that the fixed gases had to be extracted into a bag because the instrument could not overcome the high vacuums inside the wells and headers.

The mercury samples from the gas collection system were collected differently than the samples from the passive vents. An initial attempt at using a mercury dosimeter to collect the mercury demonstrated that the mercury concentrations in the gas collection system were far higher than the dosimeter was designed to measure. Once this was known, a bag sample was injected directly into the instrument. This sample was also well above the range the instrument was able to measure. The method finally used to quantitate the mercury concentrations was to use the Jerome Analyzer's calibration device, which consisted of a glass manifold, an air purification cartridge, and a rubber septum. This system works by pulling room air through a zero air filter to remove potential interferences. In the calibration mode, 1 mL of a saturated mercury headspace is injected through the septum and into the analyzer. The approach developed in the field was to use this apparatus and inject 1 mL of the sample gas from the gas collection system into the analyzer.

Samples for speciated hydrocarbon analysis were collected in SUMMA® polished stainless steel canisters. The samples were collected by first purging the sample line using a vacuum pump. After the line had been conditioned, a ball valve installed on the sample line was closed and the canister was attached. This prevented backflow of ambient air into the sample line, which would have then been sampled by the canister. The canister vacuum was used to collect the samples. Therefore, final canister vacuums were greater than or equal to the vacuum of the wells and headers (e.g., 0.25-0.30m [10-12 in.] Hg). Using canister vacuum to collect the samples minimizes the potential for sample contamination due to carryover that can occur in pumped systems. The samples were analyzed in Radian's Austin, Texas laboratories for fixed gases ($CH_4$, $CO_2$, and $O_2$), TNMOC, and speciated hydrocarbons.

### 3.2.4 Liquid and Soil Sampling

In addition to the gas sampling, a small number of landfill condensate, liquid seep, and soil samples were collected. The landfill condensate samples were collected from one of two sources. The first source was the North and South Field headers. Samples were collected directly from this source using a vacuum pump to extract the condensate from the bottom of the header pipes. This was the preferred method; however, there were several sampling periods when this was not possible because of problems with access to the headers. When this occurred, the samples were collected from the air/water separator located immediately downstream of the two headers. Condensate samples were collected during a total of eight sampling episodes. Condensate samples were collected in 40-mL VOA vials and analyzed for volatile organics compounds using SW-846 Method 8240. Samples were collected with zero headspace and cooled to 4°C immediately following sample collection. Samples were kept cool until they were analyzed, which occurred within seven days from sample collection.

Three seep samples were collected, one each from Sections 3/4, 2/8, and 6/7. The seep samples were collected at points where liquid was leaking out of the landfill. Since there were no pools of this liquid, the samples were more of a slurry than a liquid. These samples were collected in 100 mL wide-mouthed VOA vials. These samples also were stored at 4°C, and analyzed by SW-846 Method 8240 within seven days of sample collection.

Soil samples were collected from 12 locations across the landfill to evaluate the concentrations of VOCs in the surface cover matrix. Samples were collected at a depth of 8-10 cm (3-4 in.) below the landfill surface. Samples were collected in 100-mL wide-mouthed VOA vials and packed as tightly as possible to minimize headspace inside the vial. These samples were stored at 4°C and analyzed by SW-846 Method 8240 within seven days of sample collection.

Additional soil samples were collected at these same 12 locations and analyzed for physical parameters: moisture, bulk density, and particle density. These samples were collected using 0.46 m (18 in.) Shelby tubes.

## 3.3 Analytical Procedures

The analytical procedures for this program are divided into on-site analyses ($H_2S$, mercury, flow rate measurements, and landfill gases) and off-site analyses (VOC canisters and SW-846 Method 8240 Analysis). Details of the analytical methods are presented in the following subsections.

### 3.3.1 VOC Analytical Methods

Samples for speciated VOC analysis were collected in evacuated, SUMMA® polished stainless steel canisters. The VOCs were then analyzed using a gas chromatograph (GC) equipped with dual columns and multiple detectors (GC/MD). The detectors included a flame ionization detector (FID), a photoionization detector (PID), and an electrolytic conductivity detector (ELCD). The fixed gas (i.e., $O_2$, $CO_2$, and $CH_4$) analysis was performed using a thermal conductivity detector (TCD). Selected samples were also analyzed using gas chromatography with mass spectroscopy (GC/MS) to help identify compounds not identified by GC/MD. GC/MS analysis was performed on 25% of the passive vent and active landfill gas collection samples and 20% of the flux chamber samples.

When the canisters arrived in the laboratory, the final field pressures were checked to verify that the canisters did not leak during transit. Following pressure checks, the canisters were pressurized with

UHP-grade helium both to dilute the sample and facilitate its removal from the canister.

The speciated VOC sample analysis was performed using cryogenic trapping (flux chamber samples) or fixed loop injection (passive vent and landfill gas collection system samples). The GC/MD system was configured for this program without a Nafion dryer. For the samples analyzed using the cryogenic concentration technique, the traps were thermally desorbed and the material cryogenically focused onto a capillary column for separation of the compounds. One column eluent was analyzed by the FID and PID detectors arranged in series configuration with the eluent from the second column being analyzed by the ELCD. The FID/PID were used to quantitate the aromatic and aliphatic hydrocarbons. The ELCD was used to quantitate most of the halogenated hydrocarbon species. For the samples analyzed using the fixed loop system, the sample loops were purged with the sample gas, filled, and then injected onto the two columns described above. The fixed loop system was also calibrated using a fixed loop injection technique. A description of the various instruments used to analyze the samples was contained in the QAPP/Sampling Plan [Ref 2].

The peak identification was based on normalized retention times, detector responses, and individual compound response from the daily calibration standard. The retention time of each peak on the FID was calculated relative to the retention time of toluene (RRT). The PID data then were scanned for any peaks that matched the FID retention times. The corresponding PID/FID response ratio was then compared with the sample's PID/FID response for toluene to generate a toluene-normalized response (TNR) factor. Different compound classes and individual compounds produce characteristic TNRs. The RRT and TNR data were compared with the compound database parameters and the daily calibration standard analysis for potential matches. The potential matches were reviewed and validated by experienced personnel to ensure data quality.

During this program, the chromatograms were first validated for the major compounds (i.e., those contained in the calibration standard) found in the sample followed by evaluating the sample chromatograms for other major peaks. The quantitation of the major compounds was based on individual response factors for the calibrated compounds and an average carbon-based response for the non-calibrated compounds. The identification of non-calibrated compounds was based on Radian's extensive library of compounds.

### 3.3.2 Fixed Gas Analysis

The percent level analysis of the fixed gases (i.e., methane, carbon dioxide, oxygen, and carbon monoxide) were performed using a Hewlett-Packard Model 5710A gas chromatograph equipped with dual packed columns, a fixed loop injection system, and a thermal conductivity detector (TCD). Sample quantitation was based on individual compound response factors. Fixed gas analysis was performed on all canister samples.

### 3.3.3 Volatile Organic Compounds in Liquid and Soil Samples

Volatile organic compound analyses were performed on landfill condensate, landfill seep, and soil samples using SW-846 Method 8240. The samples were extracted with organic solvent, concentrated, and introduced to the instrument via a purge and trap device. The method uses scanning gas chromatography with mass spectroscopy (GC/MS). The laboratory used a Hewlett Packard Model 4500 GC/MS system. Samples were quantitated for a list of common VOCs (8240 list), plus ten tentatively identified compounds, based on concentration, from the GC/MS library.

### 3.3.4 Mercury Analysis

The vapor-phase mercury samples were either collected on gold foil dosimeters or analyzed directly from a Tedlar® bag. The mercury samples were analyzed on-site using a Jerome Model 431 Gold Film Mercury Vapor Analyzer. This system works (for dosimeter samples) by thermally desorbing the amalgamated mercury from the dosimeter onto the gold film detector inside the Jerome analyzer. For the bag samples, the air was injected directly into the analyzer where the mercury in the air sample was amalgamated to the gold foil. The analyzer then compared the increase in electrical resistance of the gold foil before and after the mercury amalgamation. The change in resistance was directly proportional to the mass of mercury in the sample. The analyzer's detection limit is approximately 0.3 ng of mercury.

### 3.3.5 Hydrogen Sulfide Analysis

The hydrogen sulfide ($H_2S$) analysis was performed on-site using a Jerome 631-X analyzer. This analyzer also uses a gold film technology to measure $H_2S$. Both the $H_2S$ and mercury analyzers contain internal scrubbers so that $H_2S$ does not interfere with the mercury analysis and vice-versa (see Section 6.2.1). This instrument has a detection limit of approximately 3 ppb.

### 3.3.6 Landfill Gas Analyzer

A Geo Group landfill gas analyzer was used on-site to measure the concentrations of methane, carbon dioxide, and oxygen. This instrument uses an infrared measurement technique to determine the concentrations of the gases. The analyzer was calibrated using methane and carbon dioxide standards; for oxygen, ambient air was used.

### 3.3.7 Soil Analyses

Bulk density measurements were made on the Shelby tubes samples. During this program, bulk density was determined using the method described in Methods of Soil Analysis, American Society of Agronomy, 1965. Using this method, the mass of the samples was calculated by difference using a top loading balance. The dimensions of the cube or cylinder were measured using a ruler. The bulk density was calculated by dividing the mass by the volume.

The particle density was determined by measuring the mass of liquid required to fill a closed container of known volume containing a known mass of solids. The volume of the liquid was calculated from the mass of the liquid and the known density of the liquid at the temperature at which the measurements are made. The volume of the solids is the difference between the volume of the container and the volume of the liquid. Particle density is the mass of the solids divided by the volume of the solids. In ASTM Method D 854, specific gravity is defined as "the ratio of the weight in air of a given volume of a material at a stated temperature to the weight in air of an equal volume of distilled water at a stated temperature." The water content or moisture content of the soil samples was determined using ATSM Method D 2216. Using this method, a measured mass of soil was dried in an oven at 110 ±5 °C until the sample reached a constant mass. The water content, expressed as a percentage, was then calculated as the ratio of the mass of water present to the mass of soil, multiplied by 100.

The particle size distribution of the soil samples was determined using ASTM D422-63. This procedure was performed in two steps. The first step, for particulates above 75 um (retained on a Number 200 sieve), used a number of sieves of various sizes to achieve fractionation down to 75 um (Number 200 sieve). In the second step, the size distribution of the material that passes the Number 200 sieve (i.e., less than 75 um) was determined by using a sedimentation process and a hydrometer.

## 4.0 RESULTS

This section contains tabulated results for the measurement program. The tabulated values have not been corrected for field, method, or system blank values, nor have they been corrected for bias, as determined from percent recovery of laboratory control samples. The results are further reduced and discussed in Section 5 and the results of quality control checks are summarized in Section 6. Additional information pertinent to the interpretation of the results is contained in the Appendices to this report. Master logs of all sample collection and measurement efforts are presented in Appendix A. The UTM coordinates for the sampling locations and for all of the monitoring wells present at Section 1/9 are given in Appendix B. Example calculations are shown in Appendix C.

The master logs are divided into separate logs for different types of measurements and these contain the following information:

**Flux Chamber Master Log:** Sample location, date, time, and description; THC screening values; flux chamber and ambient air temperature; sweep air, landfill gas, and flux chamber exhaust flow rates; sample ID and SUMMA canister #.

**Passive Vent, Gas Extraction Well, and LFG Collection System Master Logs:** Passive vent #, gas extraction well #, landfill gas collection header; flow rate; landfill section; sample date, time, and sample ID.

**Landfill Gas Monitoring Well, Condensate Sample, and Soil Master Logs:** Sample location, date, time, and ID.

The number and type of measurements made during the course of this program are summarized in Table 4-1 (all tables are located after the text and figures at the end of the section). As discussed in Section 6, the overall data set met the QA/QC criteria outlined in the QAPP. Certain qualifications to the data, however, still should be considered when reviewing the tabulated data. The data that did not meet the QA/QC acceptance criteria are presented in Table 4-2.

The analysis of landfill gas samples resulted in the identification of approximately 130 volatile organic compounds. Given the very large amount of VOC data generated during this program, only a subset of the VOC data are given in this section. The 20 or so VOCs included in the tables in this section were selected based on their frequency of occurrence and average concentration in the samples. An additional selection criterion was to include those compounds commonly reported in landfill gases. A complete list of VOC concentration measurements by GC/MD are presented in Appendix D and the corresponding emission and mass flow rates calculated from these data are presented in Appendix E. A complete list of GC/MS results are given in Appendix F.

### 4.1 Results of Sampling at Passive Vents

Measurements were made at every passive vent at the Fresh Kills landfill. The locations of the passive vents sampled on Sections 2/8, 3/4, and 1/9 are shown in Figures 4-1, 4-2, and 4-3, respectively (all figures are located after the text at the end of the section). The UTM coordinates of the passive vents on Sections 2/8 and 3/4 were supplied by NYC DOS. The exact coordinates of the passive vents on Section 1/9 were not available, so these locations are approximate.

Canister samples were collected at a subset of the passive vents with positive flow and analyzed in Radian's Austin laboratories by GC/MD for individual VOCs, $CH_4$, $CO_2$, and $O_2$. Table 4-3 presents a summary of the concentration results for all compounds from all vents and contains: compound specific detection limits; percent of samples in which the compound was detected; the minimum, maximum, median, average, standard deviation, and upper and lower 95% confidence intervals. Over 75 compounds were routinely identified in the passive vent samples. The flowrate and concentration data were used to calculate emission rates for each species from each vent (See Appendix C for example calculations). The concentration and emission rates of selected VOCs are given in Tables 4-4, 4-5, and 4-6 for landfill Sections 2/8, 3/4, and 1/9, respectively. The concentration data provide information about the composition of the landfill gas and the emission rate data provide information about the amount of landfill gas exiting through the vents.

Flowrate measurements were made at every vent. For those vents which landfill gas was flowing, the following were measured: temperature; hydrogen sulfide ($H_2S$), methane ($CH_4$), carbon dioxide ($CO_2$), and oxygen ($O_2$) concentrations. In addition, on-site mercury (Hg) measurements were made on a subset of these passive vents. The measured flow rate, concentration and emissions of these compounds are given in Tables 4-7, 4-8, and 4-9 for landfill Sections 2/8, 3/4, and 1/9, respectively. Whenever the sum of the $CH_4$, $CO_2$, and $O_2$ concentrations for a given measurement is less than 100%, the remainder of the landfill gas can be assumed to consist of nitrogen ($N_2$) plus roughly 1% VOCs.

Multiple measurements were made at five passive vents over a one week period on both Sections 2/8 and 3/4 to assess the short-term, temporal variability in emissions from these vents. The concentration and emission rate data for selected VOCs are presented in Tables 4-10 and 4-11 for landfill Sections 2/8 and 3/4, respectively. Concentration and emission rate data for Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ are presented in Tables 4-12 and 4-13 for landfill Sections 2/8 and 3/4, respectively.

During the course of the measurement program approximately 25% of the SUMMA canister samples also were analyzed by GC/MS to identify additional compounds present in the samples. The complete results for the GC/MS analysis of canister samples are given in Appendix F. The GC/MD and GC/MS results for one vent sample with reasonably high concentrations of VOCs are compared in Appendix G.

Data for fixed gases was obtained from on-site analysis of samples from every vent with positive flow and off--site analysis of canister samples which were collected at approximately 24% of the vents. Only the on-site data were used to calculate emission and mass flow rates. For informational purposes only, the results of the fixed gas analysis for the canister samples are given in Appendix H.

## 4.2 Results of Sampling at Soil Surfaces

Sampling the soil surface included: 1) flux chamber measurements to determine emission flux of VOCs, $H_2S$, $CH_4$, $CO_2$, and $O_2$, 2) collection of soil samples for analysis of VOCs, and 3) collection of landfill seep samples for analysis of VOCs.

### 4.2.1 Flux Chamber Sampling

Landfill gas emissions through the surface of landfill were measured at all four sections of the landfill. The locations of the sampling points are shown in Figures 4-4 through 4-7 for Sections 2/8, 3/4, 1/9, and 6/7, respectively. The locations of flux chamber samples were determined on-site using a portable global positioning system (GPS) with a stated accuracy of $\pm$ 10 meters. The majority of the flux measurements were performed at Section 6/7 as previously discussed in Section 3.2.2.

Canister samples were collected from every flux chamber sample and analyzed off site for VOCs, $CH_4$, $CO_2$, and $O_2$. Tedlar bag samples also were collected from every flux chamber sampling location and used for on-site measurements of hydrogen sulfide ($H_2S$) concentrations. Table 4-14 presents a summary of the VOC emission fluxes for all compounds from all flux chamber samples and contains: compound specific detection limits; percent of samples in which the compound was detected; the minimum, maximum, median, mean, standard deviation, and upper and lower 95% confidence intervals. The complete results of the concentration measurements for all VOCs are given in Appendix D (canisters by GC), Appendix F (canisters by GC/MS), and Appendix H (canisters for fixed gases). In each case, the stated concentrations are those in the flux chamber exhaust gas. The GC/MD and GC/MS results for one flux chamber sample with reasonably high concentrations of VOCs are compared in Appendix G.

Emission fluxes were calculated from the concentration data as follows:

$$\text{Emission Flux}\left(\frac{\mu g}{m^2\text{-min}}\right) = \frac{F_e * C_e}{0.13\ m^2}$$

where:

$C_E$ = Concentration in flux chamber exhaust gas ($\mu g/m^3$); and

$F_E$ = Flux chamber exhaust flow rate ($m^3$/min).

The flux chamber exhaust flow rate is the sum of the sweep air flow rate and the landfill gas flow rate into flux chamber). The value in the denominator (0.13 $m^2$) represents the landfill surface area enclosed by the flux chamber. The sweep air flow rate typically was about 0.010 $m^3$/min.

The measured emission fluxes for select VOCs, $H_2S$, $CH_4$, and $CO_2$ are presented in Tables 4-15 through 4-18 for Sections 2/8, 3/4, 1/9, and 6/7, respectively. Complete emission flux results are given in Appendix E. The emission flux of mercury was measured at five locations, and the resulting emission fluxes are shown in Table 4-19. Also, included in Table 4-19 are the emission flux of mercury measured in field blank samples.

Multiple emission flux measurements were taken at four locations on Section 6/7 over a one week period to assess the short-term, temporal variability in emission fluxes at these locations. The temporal emission fluxes for select VOCs are presented in Table 4-20. The emission flux of $CO_2$, $CH_4$, and $H_2S$ are given in Table 4-21.

### 4.2.2 Surface Soil Sampling

Soil samples were collected at 12 locations across the landfill and shipped off site for analysis of VOC content by GC/MS and physical properties by various standard methods. The results of the GC/MS analysis for all of the VOCs detected in soil samples are given in Table 4-22. The complete GC/M' :nalytical results for the soil samp. .. are given in Appendix I. The results of the physical property tests are given in Table 4-23. The results of particle size distribution tests are given in Appendix J. The physical property data were not used in this study, but were collected to assist any future emission modeling studies.

### 4.2.3 Seep Sampling

Samples were collected of the liquid (slurry) from landfill seeps at three locations and shipped off site for analysis of VOC content by GC/MS. The results of these analyses for all of the VOCs detected in the seep samples are given in Table 4-24. The complete analytical results for the liquid seep samples are given in Appendix K.

## 4.3 Results of Sampling at the Gas Collection System

Over 200 gas extraction wells are present at Section 1/9. The flow from these wells are combined into a north field and a south field and the extracted gas enters the treatment plant through two headers. Therefore, the landfill gas flow in the headers is the combined flow from all of the flowing gas extraction wells. Sampling the landfill gas collection system on Section 1/9 consisted of: 1) sampling a subset of the flowing gas extraction wells, and 2) sampling the north and south gas collection headers over several days.

### 4.3.1 Gas Collection Headers

Measurements were made at the north and south headers of the gas collection system. Table 4-25 presents a summary of the concentration results for all compounds from all gas collection header samples and contains: compound specific detection limits; percent of samples in which the compound was detected; the minimum, maximum, median, average, standard deviation, and upper and lower 95% confidence intervals. The concentration and emission rates of selected VOCs are given in Table 4-26. Complete results are given in Appendix D.

Flowrate, temperature, hydrogen sulfide ($H_2S$), mercury (Hg), methane ($CH_4$), carbon dioxide ($CO_2$), and oxygen ($O_2$) concentration measurements were made at both the south and north headers over several days to assess short-term, temporal variability in emissions from the gas collection system. All of these analyses were performed on site and the results are given in Table 4-27. As previously discussed, whenever the sum of the $CH_4$, $CO_2$, and $O_2$ concentrations for a given measurement is less than 100%, the remainder of the landfill gas can be assumed to consist of nitrogen ($N_2$) plus roughly 1%

VOCs. The flowrate and concentration data were used to calculate mass flow rates for each species (See Appendix C for example calculations).

### 4.3.2 Gas Extraction Wells

The landfill gas extraction wells present on Section 1/9 are shown in Figure 4-8. The average radius of influence of the gas extraction wells, 23m (75 ft), was provided by Air Products and is shown in Figure 4-9. The location of the wells was provided by NYC DOS and Air Products. Measurements were made at 25 of the gas extraction wells to assess the spatial variability in landfill gas composition. The same measurements and analyses were performed for the individual wells as for the combined headers.

Table 4-28 presents a summary of the VOC concentration results for all compounds from the gas extraction well samples and contains: compound specific detection limits; percent of samples in which the compound was detected; the minimum, maximum, median, average, standard deviation, and upper and lower 95% confidence intervals. The concentration and emission rates of selected VOCs are given in Table 4-29. Table 4-30 presents Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ concentration and emission rates, and measured landfill gas flow rates from each extraction well. The individual compound emission rates are based on the measured flow rates and concentrations (See Appendix C for example calculations).

Multiple measurements were made at selected gas extraction wells over several days to assess the short-term, temporal variability in emissions from these wells. The concentration and emission rates of select VOCs, and the landfill gas flow rates from each extraction well are given in Table 4-31. The landfill gas flow rate, and Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ concentrations and emissions are given in Tables 4-32.

About 25% of the canister samples also were analyzed by GC/MS to identify additional compounds present in the samples. The complete results for the GC/MS analysis of canister samples are given in Appendix F. The results of the fixed gas analysis for the canister samples are given in Appendix H. As previously mentioned, the off-site fixed gas results were not used in this report.

### 4.3.3 Landfill Gas Condensate

As the landfill gas travels from the interior of the landfill to the gas processing plant, the gas cools causing water and some VOCs to condense. In addition, as the water condenses it will tend remove water soluble (i.e., polar) VOCs such as ethanol and methanol from the gas phase. Therefore, the total mass flow of VOCs through the gas extraction system is a combination of the gas-phase and liquid-phase VOC flows.

Samples of condensate were collected at three locations: 1) south field header, 2) north field header, and 3) following the air/water separator. The condensate in the headers was found on the bottom of the headers (i.e., both landfill gas and condensate were flowing in the header lines). Both the headers merge into one line prior to the air/water separator. Therefore, the VOC concentrations in the air/water separator samples are a composite of: 1) VOC concentrations and condensate volumes in both header lines and 2) VOC concentrations and condensate volume produced by the air/water separator. All condensate samples were analyzed off-site by GC/MS for VOCs. The concentrations of all VOCs detected in the condensate are presented in Table 4-33. The complete results for the GC/MS analysis of condensate samples are given in Appendix L.

The mass flow rate of VOCs detected in the condensate samples are presented in Table 4-34. The emissions were determined by multiplying the average condensate VOC concentrations in the air/water separator samples by the amount of condensate produced. Air Products, which operates the landfill gas collection system, estimates that 45,000 to 53,000 L/day (12,000 to 14,000 gallons/day) of condensate are produced at the air/water separator. The emissions presented in Table 4-34 is based on the average VOC concentrations found in the condensate from the air/water separator and an average condensate production rate of 49,000 L/day (13,000 gallons/day).

## 4.4 Results of Sampling at Vapor Monitoring Wells

Gas samples were collected at three vapor monitoring wells on Section 3/4. Within each well, samples were collected from three discrete depths (deep, medium and shallow depths). Samples were collected for VOCs, hydrogen sulfide ($H_2S$), mercury (Hg), methane ($CH_4$), carbon dioxide ($CO_2$), and oxygen ($O_2$). The measured concentrations of selected VOCs are given in Tables 4-35 and the measured concentrations of Hg, $H_2S$, $CH_4$, $CO_2$ and $O_2$ are presented in Table 4-36.

## 4.5 Results of Activity Factor Determinations

To develop emission rate estimates for each section and for the entire landfill, activity factor data were collected from on-site observations, information provided by the NYC DOS, and calculations based on site topographical maps. The site topographical maps were used to determine surface areas and volumes of waste under the various feature/liner combinations. The topographical maps provided by NYC DOS were dated 07/19/95. The mass of waste under a given feature/liner combination was determined by multiplying the volume of waste determined from the topographical maps by an in-place density of waste of 881 kg/m$^3$ (1,485 lb/yd$^3$). The in-place density was determined by Woodward-Clyde Consultants. The activity factors are given in Table 4-37 and 4-38. The activity factors in Table 4-38 are further subdivided based on the type of cover present (clay, PVC liner, or soil) and the feature (toe, side, top, active face, and presence of landfill gas collection system).

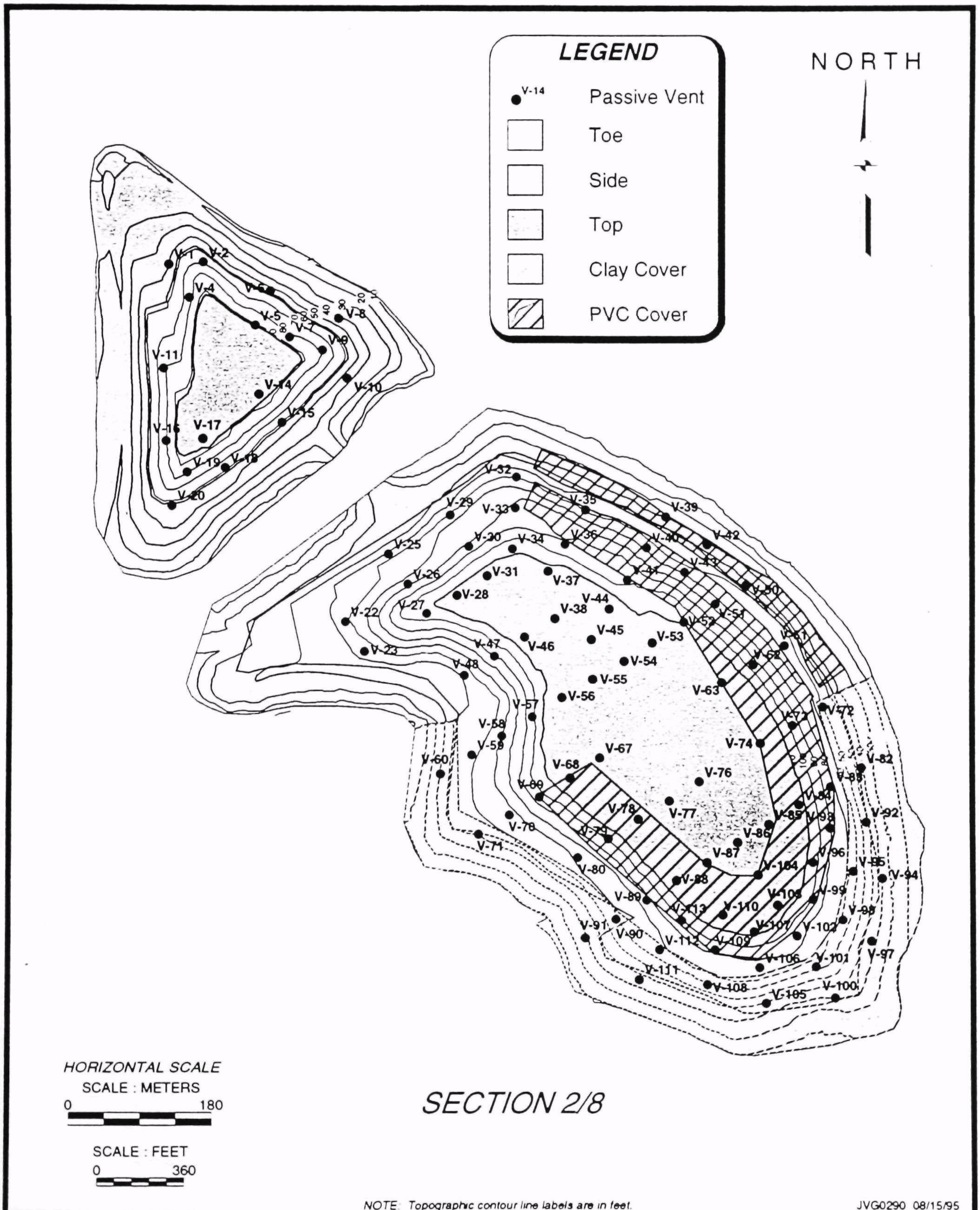


**Figure 4-1. Location of Passive Vents on Section 2/8**

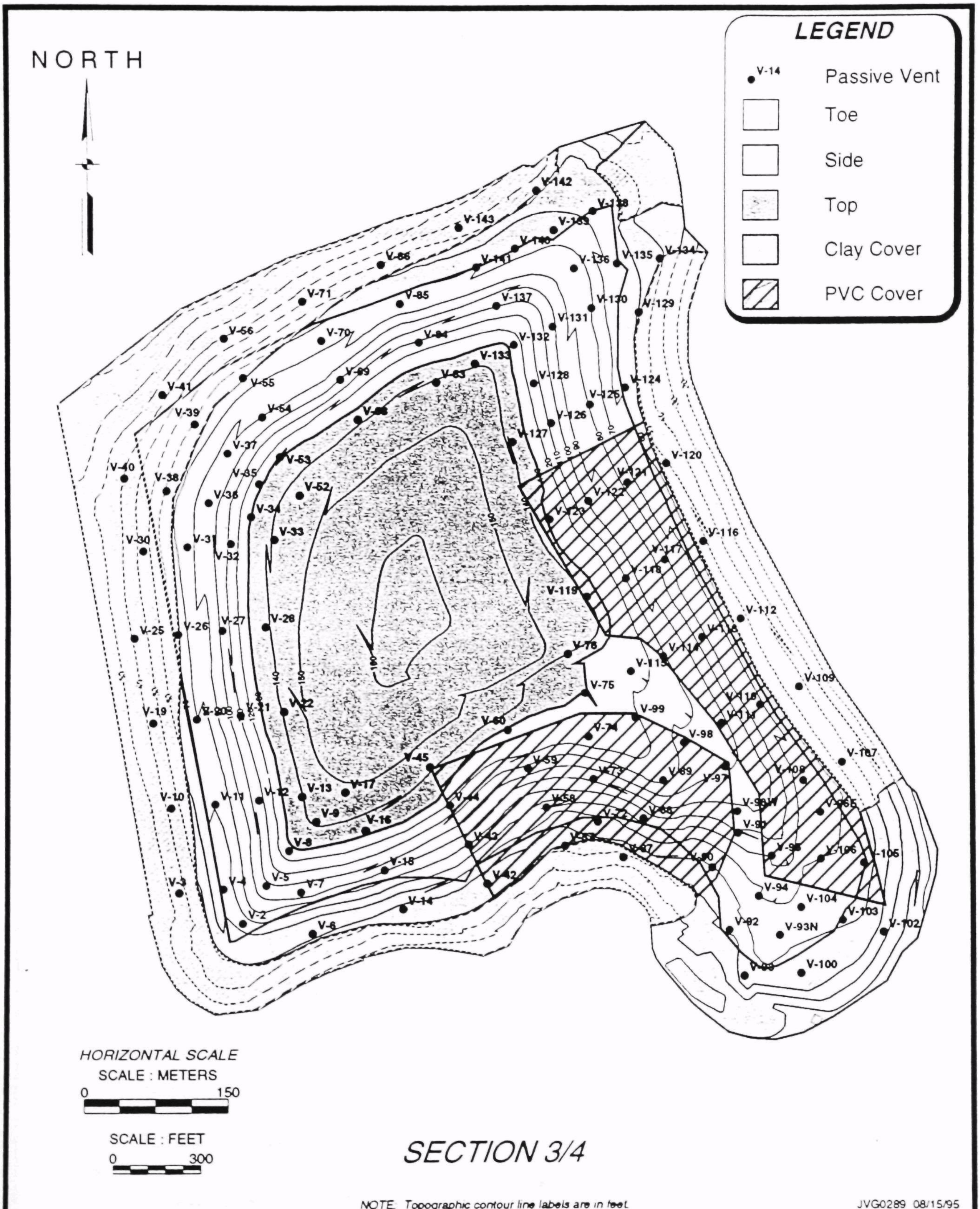


**Figure 4-2. Location of Passive Vents on Section 3/4**

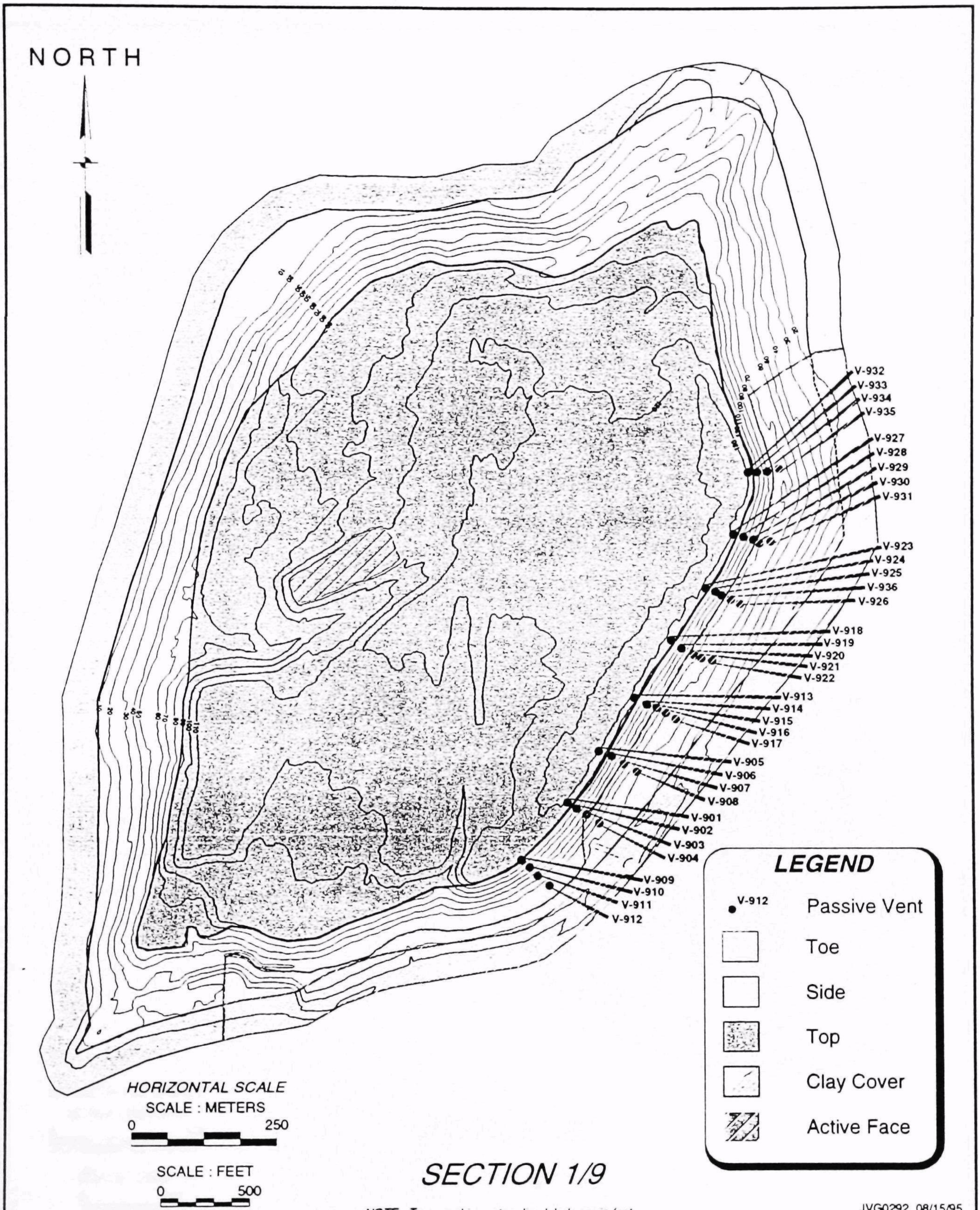


**Figure 4-3. Location of Passive Vents on Section 1/9**

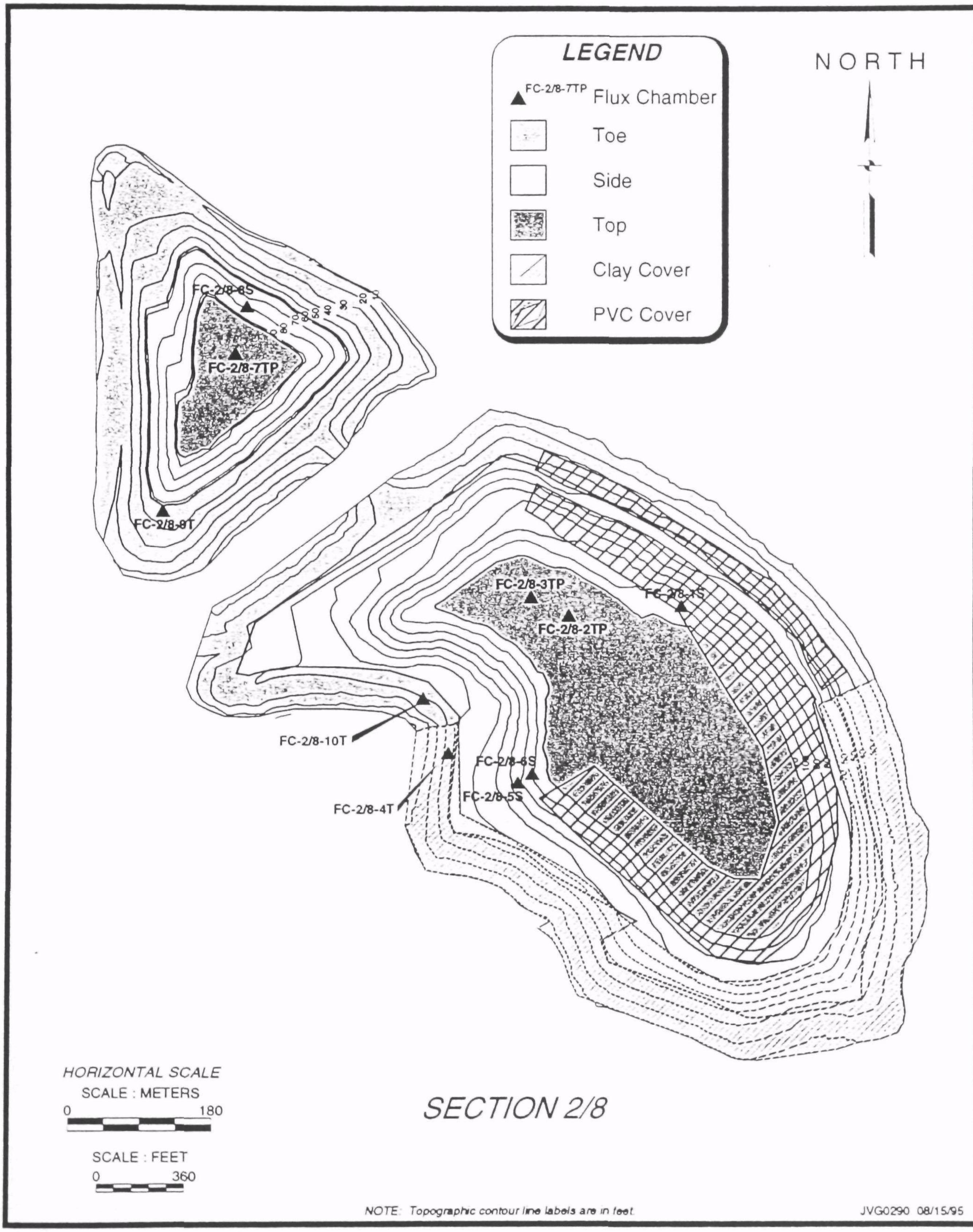


Figure 4-4. Location of Flux Chamber Sampling Points on Section 2/8

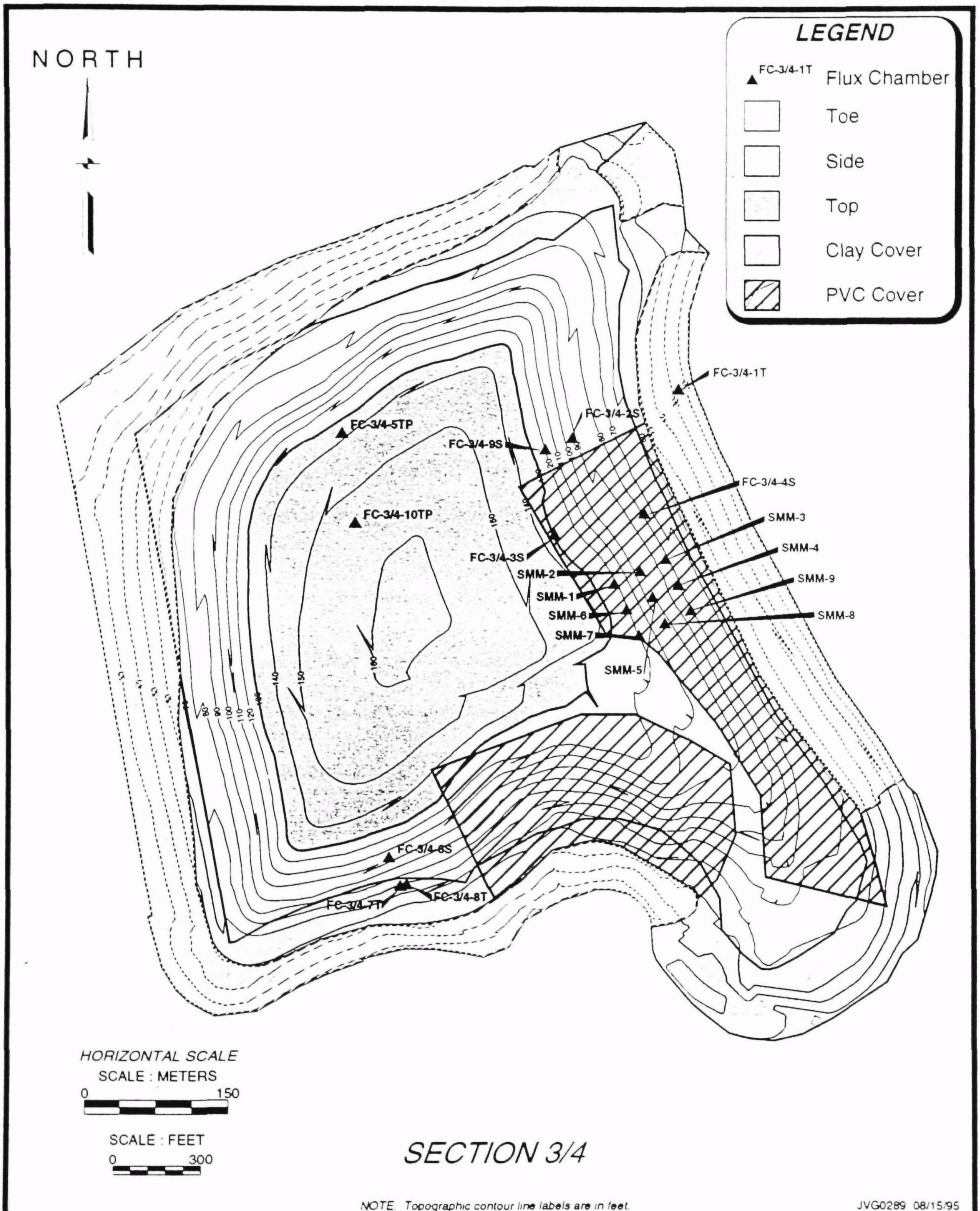


**Figure 4-5. Location of Flux Chamber Sampling Points on Section 3/4**

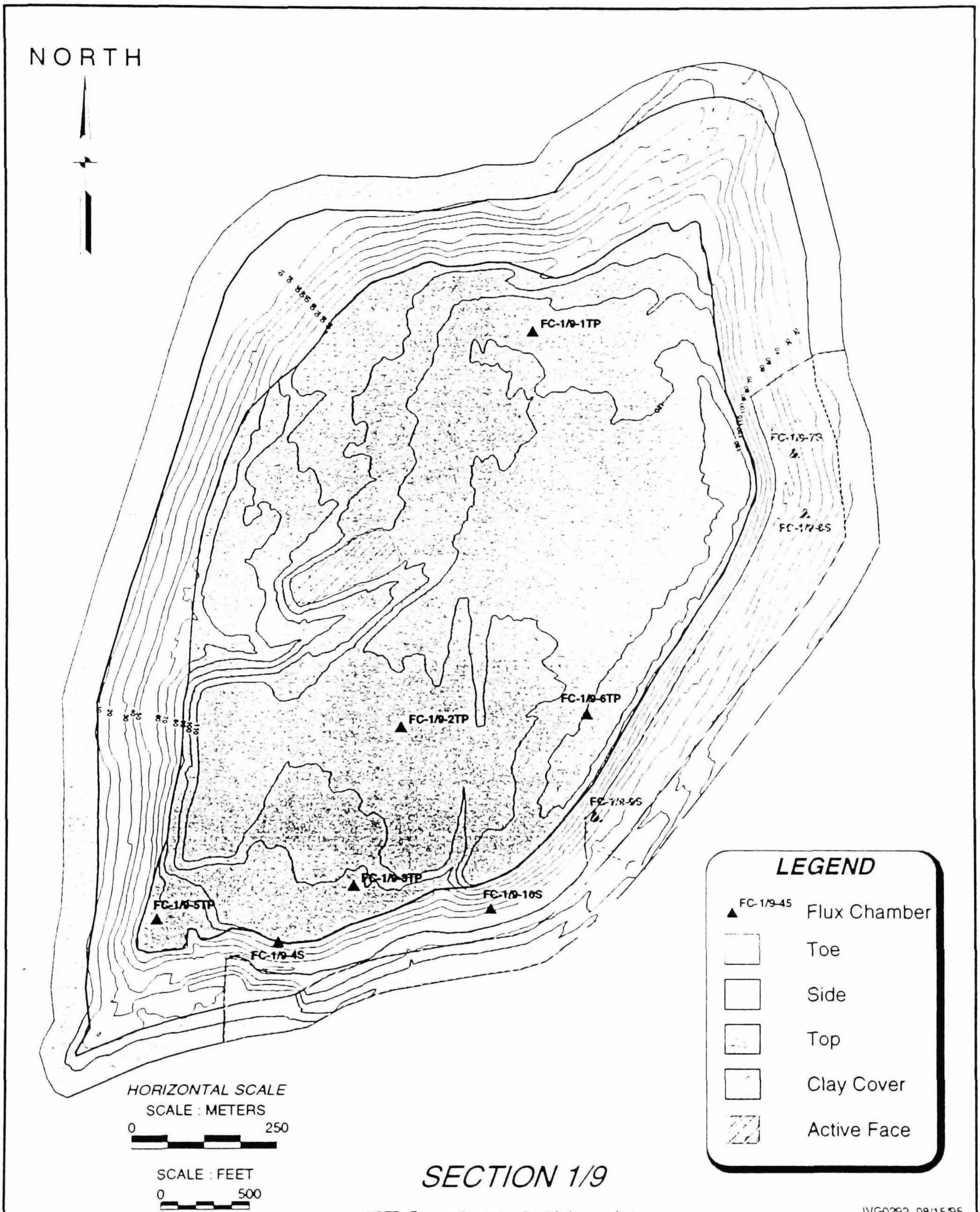


**Figure 4-6. Location of Flux Chamber Sampling Points on Section 1/9**

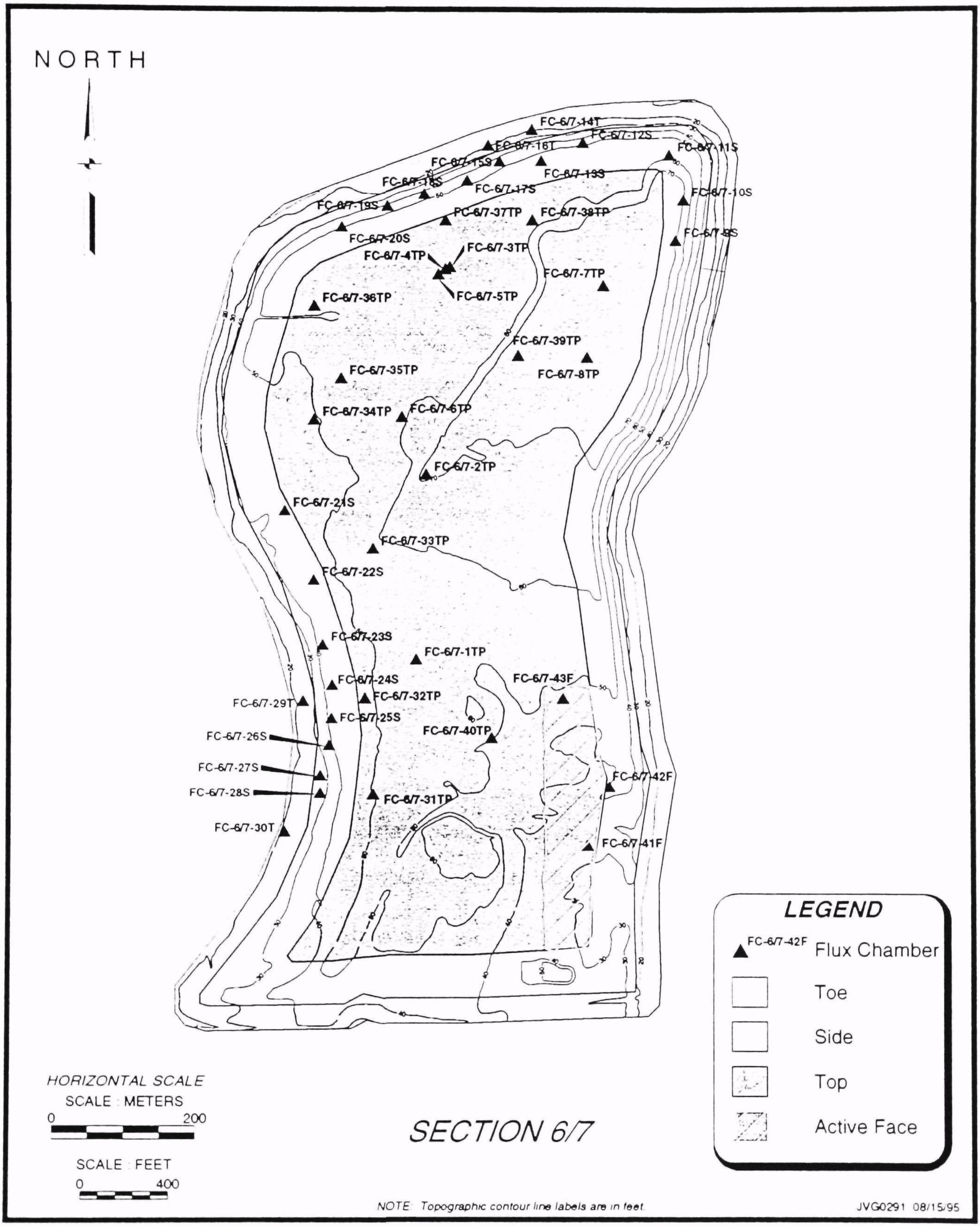


**Figure 4-7. Location of Flux Chamber Sampling Points on Section 6/7**

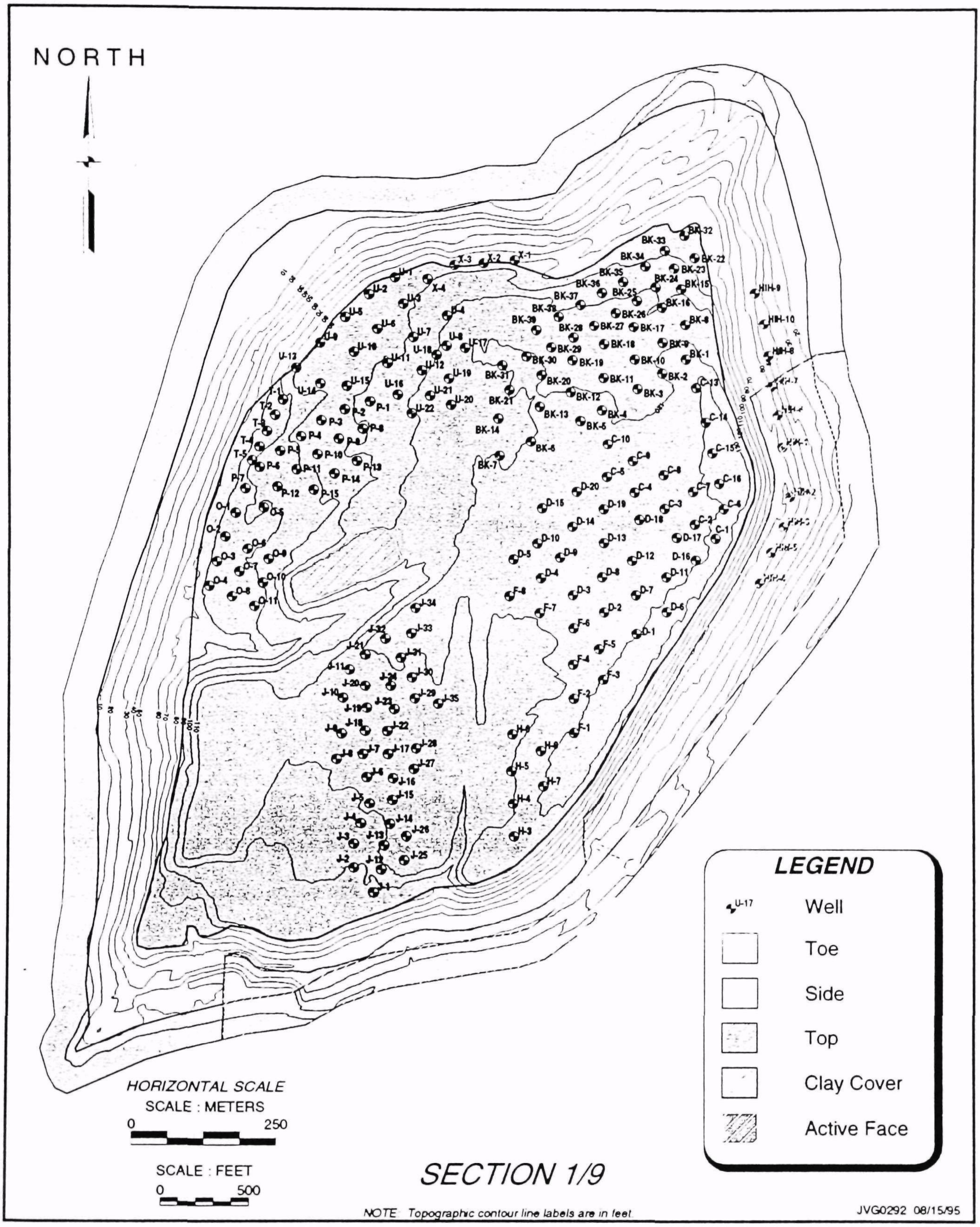


**Figure 4-8. Location of Gas Extraction Wells Sampled at Section 1/9**

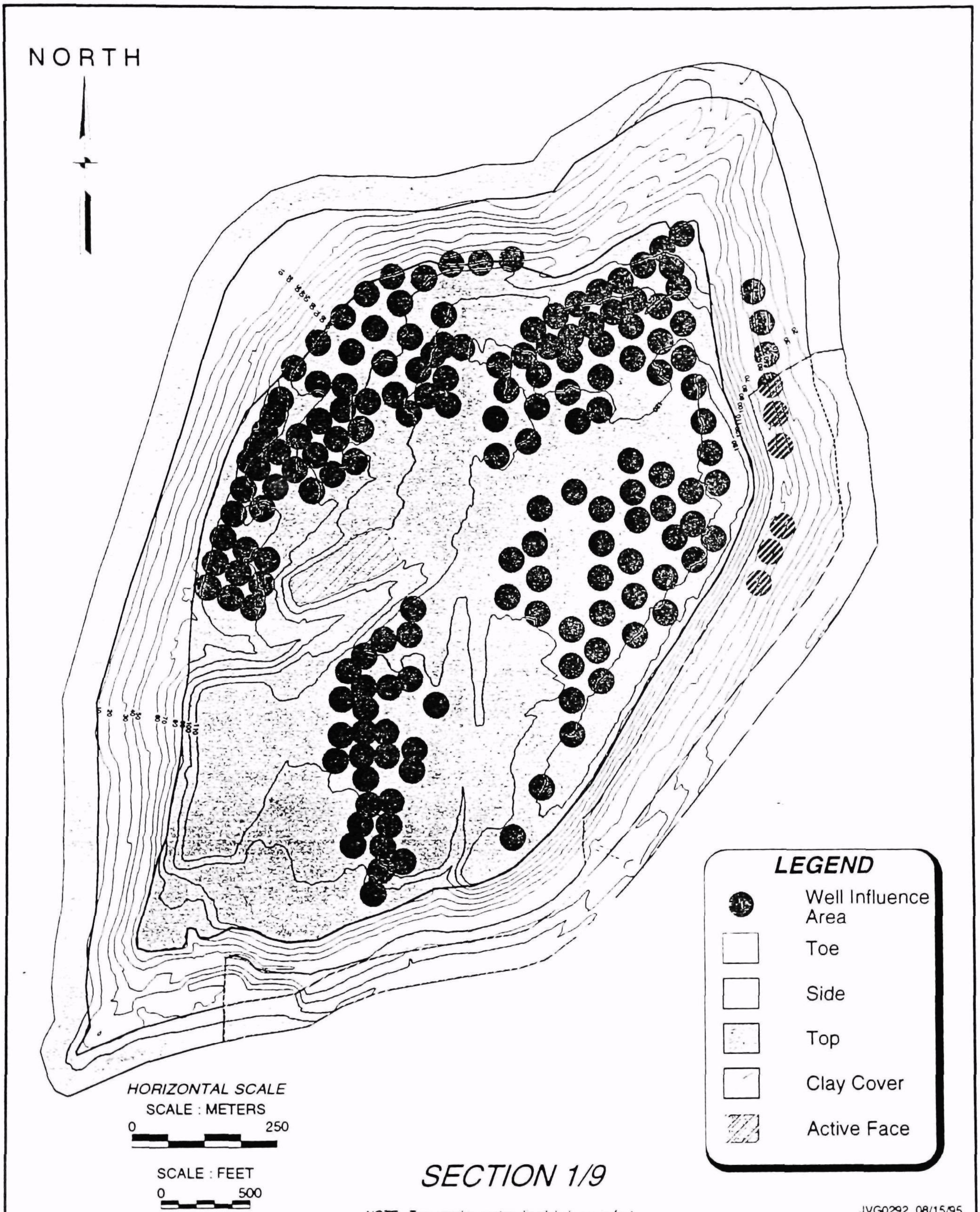


**Figure 4-9. Area of Influence of Extraction Wells Sampled at Section 1/9**

**Table 4-1**
**Number and Type of Measurements Performed**

| | Flow Rate | VOCs | $H_2S$ | Hg | THC | Fixed Gases[a] |
|---|---|---|---|---|---|---|
| Passive Vents | 231 | 95 | 215 | 61 | 0 | 202 |
| Flux Chambers | N/A | 93[b] | 88 | 8 | 9 | 0 |
| Soil | N/A | 14 | 0 | 0 | N/A | N/A |
| Seepage | N/A | 3 | 0 | 0 | N/A | N/A |
| Landfill Gas Collection System Headers | 19 | 12 | 19 | 19 | 0 | 19 |
| Condensate | 0 | 18 | 0 | 0 | N/A | N/A |
| Extraction Wells | 34 | 34 | 31 | 31 | 0 | 34 |
| Monitoring Wells | N/A | 9 | 9 | 9 | 0 | 9 |

Note: Totals include samples for temporal variability, duplicate samples, and blank samples.

[a]Totals for only on-site measurements are shown.

[b]Fixed gas measurements done off-site.

# Table 4-2
# Summary of QA/QC Criteria Exceedances

| Type of Sample and Analysis | Compound | Exceedances of QA/QC Criteria | Implication |
|---|---|---|---|
| Landfill Gas Collection System Header Flow ROTC Measurements | flow rate | No QA/QC criteria. However, measured flow rates of landfill gas was roughly double the values reported by the gas plant. Flow rate estimates were based on a duct diameter of 18" and a moisture content equal to the saturation levels of the landfill gas at the measured temperatures. | If flow rates are based high, then all emissions rates would be based high. |
| VOC Analysis of Canisters from Passive Vents | Propane | The recovery of propane was high (317%) in one audit sample. | The field data for propane at low-ppm levels may have a positive bias. |
| VOC Analysis of Canisters from Gas Collection System | | None | |
| VOC Analysis of Canisters from Flux Chambers | Styrene | The average styrene % recovery from laboratory control samples was 41.8% compared with acceptance criteria was 70% to 130%. | Styrene values are biased low. |
| | 1-Hexene | The average 1-hexene method blank value was 0.73 ppb compared with the acceptance criteria for 1-hexene was 0.3 ppb. | The average value of 1-hexene found in flux chamber samples (9.8 ppb) is well above the blank value, so the measured 1-hexene values are not significantly affected. |
| | Ethane | The recovery of ethane was low (31% recovery) in one audit sample. | Potential low bias for ethane measurements. |

# Table 4-2
# (Continued)

| Type of Sample and Analysis | Compound | Exceedances of QA/QC Criteria | Implication |
|---|---|---|---|
| Voc Analysis of Canisters from Flux Chambers (Continued) | Acetone<br>Cyclopentane<br>Diethyl ether + 2-propanol<br>Ethanol + acetonitrile<br>Methanol<br>Isobutane<br>Isobutene + 1-butene<br>Isopentane<br>Limonene<br>Nitrogen<br>Oxygen<br>Propylene<br>Toluene | The field blank values were well above the detection limits for these compounds. However, the high level concentrations of nitrogen (5.36% to 6.70%) and oxygen (1.45% to 1.92%) found in all three field blanks suggest that ambient air leaked into the flux chamber during sampling; the ratio of nitrogen to oxygen in ambient air is 3.76 and that found in the field blanks ranged from 3.40 to 3.70. | The field blank data is of little value to asses contamination from the flux chamber. However, the filed blank concentrations for all compounds except Diethyl ether + 2-Propanol, are significantly below the average values found in flux chamber samples. |
| VOC Analysis of Surface Soil Samples | Acetone | Acetone concentrations in trip blank samples ranged from 4.27 to 7.03 µg/L (detection limit are 1.6 µg/L) compared with acetone values for soil samples of 5.47 to 7.84 µg/kg. | Acetone values are suspect. |
| VOC Analysis of Liquid Samples of Seeps and Condensate | Acetone<br>2-Butanone | Acetone and 2-butanone concentrations in trip blank samples ranged from 4.27 to 7.03 µg/L and 21.6 to 27.6 µg/L, respectively (detection limits are 1.6 µg/L and 2.87 µg/L for acetone and 2-butanone). | Acetone and 2-butanone values found in liquid seep and condensate samples were either not-detected or were three orders of magnitude greater than the trip blank values. Sample contamination does not significantly affect the results for either of these compounds |
| Fixed Gas Analysis of Canister Samples | Carbon dioxide | None. However, based on mass balance closures and ratios of fixed gases, the carbon dioxide values in the field samples appear to be high for vents in Section 3/4. | None. On-site analytical results were used in lieu of off-site results. |

# Table 4-3
## Summary Statistics for Passive Vent Concentration Data

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Carbon Dioxide | 0.20% | 100 | 172 | 2.70% | 48.40% | 41.20% | 37.68% | 9.54% | 36.25% | 39.12% |
| Methane | 0.08% | 100 | 172 | 1.50% | 69.10% | 58.55% | 53.39% | 14.12% | 51.26% | 55.52% |
| Oxygen | 0.14% | 100 | 172 | ND | 18.30% | 2.29% | 4.12% | 1.66% | 2.91% | 5.33% |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.25 | 100 | 70 | 0.11 | 11.26 | 4.98 | 4.73 | 2.70 | 4.09 | 5.38 |
| 1,3,5-Trimethylbenzene | 0.07 | 100 | 70 | 0.09 | 6.35 | 2.48 | 2.51 | 1.34 | 2.19 | 2.83 |
| 3-Methylheptane | 0.25 | 100 | 70 | 0.06 | 1.20 | 0.40 | 0.43 | 0.22 | 0.38 | 0.48 |
| 3-Methylhexane | 0.25 | 100 | 70 | 0.07 | 2.49 | 0.40 | 0.56 | 0.50 | 0.44 | 0.68 |
| Cumene | 0.25 | 100 | 70 | 0.10 | 1.77 | 0.69 | 0.71 | 0.42 | 0.61 | 0.81 |
| Ethane | 0.25 | 100 | 70 | 116.48 | 309.05 | 218.53 | 217.02 | 42.13 | 206.98 | 227.07 |
| Hexanal | 0.25 | 100 | 70 | 0.14 | 1.94 | 0.73 | 0.75 | 0.40 | 0.66 | 0.85 |
| Limonene | 0.25 | 100 | 70 | 0.36 | 57.26 | 12.11 | 15.13 | 12.44 | 12.16 | 18.09 |
| Methylcyclohexane | 0.25 | 100 | 70 | 0.14 | 2.44 | 0.59 | 0.70 | 0.44 | 0.60 | 0.81 |
| b-Pinene | 0.25 | 100 | 70 | 0.09 | 7.94 | 1.41 | 1.74 | 1.48 | 1.39 | 2.09 |
| a-Pinene | 0.25 | 100 | 70 | 0.16 | 25.54 | 7.93 | 8.50 | 6.12 | 7.04 | 9.96 |
| Total Unidentified VOCs | 0.25 | 100 | 70 | 3.09 | 368.54 | 119.93 | 122.21 | 72.33 | 104.96 | 139.46 |
| Toluene | 0.02 | 100 | 70 | 0.09 | 56.38 | 18.39 | 19.85 | 15.14 | 16.24 | 23.46 |
| TNMHC | 0.25 | 100 | 70 | 63.85 | 1046 | 429.5 | 417.18 | 191.55 | 371.50 | 462.85 |
| Styrene | 0.04 | 100 | 70 | 0.20 | 6.49 | 2.28 | 2.46 | 1.43 | 2.12 | 2.80 |
| Propane | 0.25 | 100 | 70 | 1.52 | 41.45 | 14.07 | 15.92 | 8.13 | 13.98 | 17.86 |
| Ethylbenzene | 0.04 | 100 | 70 | 0.10 | 16.43 | 7.04 | 7.09 | 4.43 | 6.04 | 8.15 |
| p-Xylene + m-Xylene | 0.2 | 100 | 70 | 0.03 | 30.15 | 9.70 | 10.42 | 7.48 | 8.64 | 12.20 |
| p-Diethylbenzene | 0.25 | 100 | 70 | 0.06 | 6.73 | 2.34 | 2.49 | 1.54 | 2.12 | 2.85 |
| o-Xylene | 0.05 | 100 | 70 | 0.19 | 14.76 | 3.52 | 3.79 | 2.64 | 3.16 | 4.42 |
| o-Ethyltoluene | 0.25 | 100 | 70 | 0.10 | 9.75 | 4.21 | 4.32 | 2.17 | 3.80 | 4.84 |
| n-Undecane | 0.25 | 100 | 70 | 0.05 | 7.55 | 2.35 | 2.45 | 1.73 | 2.03 | 2.86 |
| n-Propylbenzene | 0.25 | 100 | 70 | 0.11 | 5.83 | 2.82 | 2.74 | 1.32 | 2.43 | 3.06 |
| n-Pentane | 0.25 | 100 | 70 | 0.13 | 7.71 | 0.40 | 0.87 | 1.40 | 0.53 | 1.20 |
| n-Octane | 0.25 | 100 | 70 | 0.18 | 5.10 | 1.42 | 1.63 | 1.06 | 1.38 | 1.88 |

# Table 4-3
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| n-Nonane | 0.25 | 100 | 70 | 0.17 | 15.49 | 5.75 | 5.84 | 3.31 | 5.05 | 6.63 |
| n-Decane & p-Dichlorobenzene | 0.1 | 100 | 70 | 0.19 | 28.68 | 12.96 | 12.18 | 7.30 | 10.44 | 13.93 |
| n-Butane | 0.25 | 100 | 70 | 0.44 | 11.92 | 3.37 | 4.02 | 2.32 | 3.46 | 4.57 |
| Cyclohexane | 0.25 | 100 | 70 | 0.11 | 4.25 | 0.53 | 0.76 | 0.72 | 0.59 | 0.93 |
| Chlorobenzene | 0.03 | 100 | 70 | 0.24 | 4.57 | 2.04 | 2.08 | 0.87 | 1.87 | 2.28 |
| 1,2,3-Trimethylbenzene | 0.25 | 98.6 | 70 | ND | 2.82 | 1.27 | 1.29 | 0.71 | 1.12 | 1.46 |
| n-Heptane | 0.25 | 98.6 | 70 | ND | 3.29 | 0.77 | 0.91 | 0.59 | 0.76 | 1.05 |
| m-Diethylbenzene | 0.25 | 98.6 | 70 | ND | 3.86 | 1.23 | 1.26 | 0.75 | 1.08 | 1.44 |
| m-Ethyltoluene | 0.25 | 98.6 | 70 | ND | 8.47 | 3.32 | 3.59 | 2.00 | 3.11 | 4.07 |
| Benzene | 0.04 | 98.6 | 70 | ND | 1.46 | 0.51 | 0.53 | 0.27 | 0.47 | 0.60 |
| Methylcyclopentane | 0.25 | 98.6 | 70 | ND | 2.21 | 0.30 | 0.43 | 0.42 | 0.33 | 0.53 |
| Isobutane | 0.25 | 98.6 | 70 | ND | 32.41 | 8.38 | 9.08 | 6.23 | 7.59 | 10.56 |
| 1-Octene | 0.25 | 97.1 | 70 | ND | 1.05 | 0.34 | 0.37 | 0.20 | 0.32 | 0.41 |
| p-Ethyltoluene | 0.07 | 97.1 | 70 | ND | 6.97 | 2.11 | 2.32 | 1.63 | 1.93 | 2.71 |
| Benzyl Chloride &m-Dichlorobenzene | 0.16 | 97.1 | 70 | ND | 4.23 | 1.56 | 1.67 | 1.10 | 1.41 | 1.93 |
| 2-Methyl-1-Butene | 0.25 | 97.1 | 70 | ND | 1.76 | 0.33 | 0.40 | 0.26 | 0.34 | 0.46 |
| 2,3,4-Trimethylpentane | 0.25 | 95.7 | 70 | ND | 3.23 | 0.18 | 0.34 | 0.48 | 0.22 | 0.45 |
| 2-Methyl-2-Butene | 0.25 | 95.7 | 70 | ND | 2.79 | 0.22 | 0.37 | 0.48 | 0.26 | 0.49 |
| Isobutene + 1-Butene | 0.25 | 95.7 | 70 | ND | 4.27 | 1.05 | 1.15 | 0.80 | 0.96 | 1.34 |
| Isoheptane + 2,3-Dimethylpentane | 0.25 | 95.7 | 70 | ND | 4.27 | 0.46 | 0.84 | 0.90 | 0.62 | 1.05 |
| Dichlorodifluoromethane | 0.25 | 95.7 | 70 | ND | 5.23 | 1.20 | 1.52 | 1.22 | 1.23 | 1.81 |
| 2,2,4-Trimethylpentane | 0.25 | 94.3 | 70 | ND | 2.85 | 0.43 | 0.58 | 0.52 | 0.46 | 0.70 |
| Isobutylbenzene | 0.25 | 94.3 | 70 | ND | 6.51 | 0.75 | 0.80 | 0.79 | 0.61 | 0.98 |
| Isopentane | 0.25 | 94.3 | 70 | ND | 18.66 | 0.59 | 2.06 | 3.82 | 1.15 | 2.97 |
| Naphthalene | 0.25 | 94.3 | 70 | ND | 0.72 | 0.12 | 0.18 | 0.14 | 0.15 | 0.21 |
| Vinyl Chloride | 0.32 | 90.0 | 70 | ND | 11.01 | 1.60 | 1.97 | 1.98 | 1.50 | 2.44 |
| n-Hexane | 0.25 | 90.0 | 70 | ND | 31.78 | 0.61 | 1.70 | 5.14 | 0.48 | 2.93 |

# Table 4-3
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| c-1,2-Dichloroethylene | 0.22 | 87.1 | 70 | ND | 8.94 | 0.49 | 1.10 | 1.69 | 0.70 | 1.51 |
| n-Butylbenzene | 0.25 | 87.1 | 70 | ND | 2.86 | 1.14 | 1.17 | 0.78 | 0.98 | 1.35 |
| 1,1-Dichloroethane | 0.19 | 85.7 | 70 | ND | 4.35 | 0.24 | 0.59 | 0.93 | 0.37 | 0.81 |
| Tetrachloroethylene | 0.36 | 85.7 | 70 | ND | 5.03 | 0.25 | 0.73 | 1.01 | 0.49 | 0.97 |
| 1,2,4-Trichlorobenzene | 0.25 | 84.3 | 70 | ND | 0.73 | 0.19 | 0.23 | 0.14 | 0.19 | 0.26 |
| o-Dichlorobenzene | 0.14 | 84.3 | 70 | ND | 3.18 | 1.80 | 1.59 | 0.96 | 1.36 | 1.82 |
| Trichlorofluoromethane | 0.18 | 82.9 | 70 | ND | 1.73 | 0.15 | 0.30 | 0.39 | 0.21 | 0.40 |
| 2,2,5-Trimethylhexane | 0.25 | 80.0 | 70 | ND | 0.54 | 0.18 | 0.22 | 0.11 | 0.19 | 0.25 |
| Trichloroethene | 0.33 | 78.6 | 70 | ND | 2.71 | 0.15 | 0.40 | 0.48 | 0.29 | 0.52 |
| Chloromethane/Halocarbon 114 | 0.44 | 77.1 | 70 | ND | 2.60 | 0.11 | 0.25 | 0.32 | 0.17 | 0.33 |
| Isohexane | 0.25 | 77.1 | 70 | ND | 1.90 | 0.20 | 0.31 | 0.33 | 0.23 | 0.39 |
| 1,1,1-Trichloroethane | 0.18 | 72.9 | 70 | ND | 0.66 | 0.06 | 0.13 | 0.13 | 0.10 | 0.17 |
| 3-Methyl-1-Butene | 0.25 | 71.4 | 70 | ND | 0.46 | 0.13 | 0.15 | 0.06 | 0.13 | 0.16 |
| Neohexane | 0.25 | 71.4 | 70 | ND | 0.60 | 0.10 | 0.16 | 0.11 | 0.14 | 0.19 |
| Cyclopentane | 0.25 | 68.6 | 70 | ND | 2.23 | 0.17 | 0.35 | 0.43 | 0.25 | 0.45 |
| Chloroethane | 0.22 | 67.1 | 70 | ND | 1.57 | 0.17 | 0.30 | 0.30 | 0.23 | 0.37 |
| 1-Undecene | 0.25 | 65.7 | 70 | ND | 2.17 | 0.47 | 0.72 | 0.67 | 0.56 | 0.88 |
| 3-Methylpentane | 0.25 | 65.7 | 70 | ND | 19.08 | 0.18 | 0.56 | 2.28 | 0.02 | 1.11 |
| 1,1,2,2-Tetrachloroethane | 0.32 | 64.3 | 70 | ND | 0.44 | 0.02 | 0.09 | 0.09 | 0.07 | 0.11 |
| 1-Hexene | 0.25 | 62.9 | 70 | ND | 2.05 | 0.12 | 0.32 | 0.37 | 0.23 | 0.41 |
| Methylene Chloride | 0.31 | 62.9 | 70 | ND | 11.08 | 0.06 | 0.90 | 2.32 | 0.35 | 1.45 |
| 2,2,3-Trimethylpentane | 0.25 | 61.4 | 70 | ND | 0.48 | 0.07 | 0.16 | 0.11 | 0.13 | 0.19 |
| t-2-Pentene | 0.25 | 61.4 | 70 | ND | 2.79 | 0.11 | 0.39 | 0.53 | 0.26 | 0.51 |
| Isoprene | 0.25 | 61.4 | 70 | ND | 0.91 | 0.12 | 0.17 | 0.14 | 0.13 | 0.20 |
| Dichlorotoluene | 0.25 | 60.0 | 70 | ND | 1.05 | 0.21 | 0.30 | 0.23 | 0.24 | 0.35 |
| Indan | 0.25 | 55.7 | 70 | ND | 6.44 | 0.55 | 1.17 | 1.40 | 0.84 | 1.51 |
| Acetone | 0.25 | 50.0 | 70 | ND | 20.99 | 0.04 | 2.25 | 4.52 | 1.17 | 3.32 |
| 2,5-Dimethylhexane | 0.25 | 45.7 | 70 | ND | 0.51 | NC | 0.15 | 0.10 | 0.13 | 0.18 |

# Table 4-3
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4-Dimethylpentane | 0.25 | 44.3 | 70 | ND | 2.86 | NC | 0.18 | 0.34 | 0.10 | 0.26 |
| t-2-Butene | 0.25 | 44.3 | 70 | ND | 2.73 | NC | 0.24 | 0.42 | 0.14 | 0.34 |
| Hexachloro-1,3-Butadiene | 0.25 | 42.9 | 70 | ND | 1.75 | NC | 0.16 | 0.21 | 0.11 | 0.21 |
| c-2-Butene | 0.25 | 42.9 | 70 | ND | 0.36 | NC | 0.13 | 0.07 | 0.11 | 0.14 |
| 2-Methylheptane | 0.25 | 38.6 | 70 | ND | 1.00 | NC | 0.15 | 0.14 | 0.12 | 0.19 |
| 1,1-Dichloroethylene | 3.15 | 32.9 | 70 | ND | 0.10 | NC | 1.06 | 1.00 | 0.82 | 1.30 |
| 1-Decene | 0.25 | 32.9 | 70 | ND | 0.82 | NC | 0.26 | 0.24 | 0.20 | 0.32 |
| c-2-Octene | 0.25 | 32.9 | 70 | ND | 0.39 | NC | 0.16 | 0.10 | 0.13 | 0.18 |
| t-3-Heptene | 0.25 | 28.6 | 70 | ND | 1.13 | NC | 0.18 | 0.16 | 0.14 | 0.22 |
| 3,5,5-Trimethylhexene | 0.25 | 27.1 | 70 | ND | 0.86 | NC | 0.15 | 0.12 | 0.13 | 0.18 |
| t-2-Heptene | 0.25 | 25.7 | 70 | ND | 1.65 | NC | 0.14 | 0.21 | 0.09 | 0.19 |
| Ethanol & Acetonitrile | 0.25 | 24.3 | 70 | ND | 468.30 | NC | 18.89 | 62.43 | 4.00 | 33.77 |
| t-1,2-Dichloroethylene | 0.25 | 24.3 | 70 | ND | 0.19 | NC | 0.11 | 0.07 | 0.09 | 0.13 |
| Methylisobutylketone | 0.25 | 20.0 | 70 | ND | 0.80 | NC | 0.14 | 0.11 | 0.11 | 0.16 |
| 1,4-Dioxane | 0.25 | 18.6 | 70 | ND | 0.47 | NC | 0.16 | 0.10 | 0.13 | 0.18 |
| c-1,3-Dichloropropene | 0.77 | 18.6 | 70 | ND | 0.14 | NC | 0.33 | 0.23 | 0.28 | 0.39 |
| Heptanal | 0.25 | 18.6 | 70 | ND | 1.07 | NC | 0.22 | 0.21 | 0.17 | 0.27 |
| Bromodichloromethane | 0.25 | 18.6 | 70 | ND | 0.14 | NC | 0.12 | 0.07 | 0.11 | 0.14 |
| 2-Methyl-2-Pentene | 0.25 | 18.6 | 70 | ND | 6.86 | NC | 0.31 | 0.93 | 0.09 | 0.53 |
| 1-Pentene | 0.25 | 18.6 | 70 | ND | 0.56 | NC | 0.16 | 0.09 | 0.14 | 0.18 |
| 1-Heptene | 0.25 | 18.6 | 70 | ND | 0.26 | NC | 0.13 | 0.07 | 0.11 | 0.15 |
| Cyclopentene | 0.25 | 14.3 | 70 | ND | 0.45 | NC | 0.13 | 0.08 | 0.11 | 0.15 |
| Freon 113 | 0.87 | 12.9 | 70 | ND | 0.14 | NC | 0.40 | 0.26 | 0.33 | 0.46 |
| c-3-Heptene | 0.25 | 12.9 | 70 | ND | 3.38 | NC | 0.27 | 0.47 | 0.16 | 0.38 |
| 1,2-Dichloroethane | 0.37 | 11.4 | 70 | ND | 0.08 | NC | 0.19 | 0.12 | 0.16 | 0.22 |
| 1-Methylcyclohexene | 0.25 | 11.4 | 70 | ND | 0.62 | NC | 0.17 | 0.12 | 0.14 | 0.20 |
| Bromomethane | 0.37 | 10.0 | 70 | ND | 2.31 | NC | 0.30 | 0.40 | 0.20 | 0.39 |
| c-2-Pentene | 0.25 | 10.0 | 70 | ND | 3.02 | NC | 0.18 | 0.36 | 0.09 | 0.26 |

# Table 4-3
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Lower (ppm) | Upper (ppm) |
| 2,4,4-Trimethyl-1-Pentene | 0.25 | 8.6 | 70 | ND | 0.08 | NC | 0.12 | 0.07 | 0.10 | 0.14 |
| 2-Ethyl-1-Butene | 0.25 | 8.6 | 70 | ND | 0.51 | NC | 0.14 | 0.08 | 0.12 | 0.16 |
| p-Isopropyltoluene | 0.25 | 8.6 | 70 | ND | 21.52 | NC | 0.54 | 2.58 | 0.00 | 1.15 |
| Methyl t-Butylether | 0.25 | 8.6 | 70 | ND | 28.51 | NC | 0.99 | 4.02 | 0.03 | 1.95 |
| c-3-Hexene | 0.25 | 7.1 | 70 | ND | 1.47 | NC | 0.15 | 0.18 | 0.10 | 0.19 |
| m-Chlorotoluene | 0.25 | 7.1 | 70 | ND | 1.91 | NC | 0.18 | 0.25 | 0.12 | 0.23 |
| 1-Butanol | 0.25 | 5.7 | 70 | ND | 9.08 | NC | 0.30 | 1.11 | 0.03 | 0.56 |
| Benzaldehyde | 0.25 | 5.7 | 70 | ND | 0.98 | NC | 0.17 | 0.18 | 0.12 | 0.21 |
| 4-Nonene | 0.25 | 5.7 | 70 | ND | 1.53 | NC | 0.17 | 0.25 | 0.11 | 0.23 |
| c-4-Methyl-2-Pentene | 0.25 | 5.7 | 70 | ND | 0.21 | NC | 0.14 | 0.07 | 0.12 | 0.15 |
| o-Chlorotoluene | 0.25 | 5.7 | 70 | ND | 1.99 | NC | 0.18 | 0.33 | 0.11 | 0.26 |
| 2,3-Dimethylbutane | 0.25 | 4.3 | 70 | ND | 0.22 | NC | 0.13 | 0.07 | 0.12 | 0.15 |
| t-2-Hexene | 0.25 | 4.3 | 70 | ND | 0.20 | NC | 0.12 | 0.07 | 0.10 | 0.13 |
| Diethyl Ether &2-Propanol | 0.25 | 4.3 | 70 | ND | 1.44 | NC | 0.16 | 0.19 | 0.11 | 0.20 |
| 1,2-Dibromoethane | 0.28 | 2.9 | 70 | ND | 0.05 | NC | 0.14 | 0.08 | 0.12 | 0.16 |
| t-1,3-Dichloropropene | 0.13 | 2.9 | 70 | ND | 0.12 | NC | 0.07 | 0.04 | 0.06 | 0.08 |
| c-2-Hexene | 0.25 | 2.9 | 70 | ND | 3.10 | NC | 0.16 | 0.37 | 0.07 | 0.25 |
| Neopentane | 0.25 | 2.9 | 70 | ND | 0.14 | NC | 0.13 | 0.07 | 0.11 | 0.15 |
| Methanol | 0.25 | 2.9 | 70 | ND | 0.75 | NC | 0.14 | 0.12 | 0.11 | 0.16 |
| Chloroprene | 0.25 | 2.9 | 70 | ND | 0.16 | NC | 0.15 | 0.07 | 0.13 | 0.17 |
| Bromochloromethane | 0.25 | 2.9 | 70 | ND | 0.27 | NC | 0.12 | 0.08 | 0.11 | 0.14 |
| 4-Methyl-1-Pentene | 0.25 | 2.9 | 70 | ND | 0.23 | NC | 0.12 | 0.07 | 0.10 | 0.13 |
| 1,2-Dichloropropane | 0.22 | 1.4 | 70 | ND | 0.04 | NC | 0.10 | 0.06 | 0.09 | 0.12 |
| c-3-Methyl-2-Pentene | 0.25 | 1.4 | 70 | ND | 0.34 | NC | 0.11 | 0.08 | 0.09 | 0.13 |
| Vinyl Acetate | 0.25 | 1.4 | 70 | ND | 0.42 | NC | 0.14 | 0.08 | 0.12 | 0.16 |
| Cyclohexene | 0.25 | 1.4 | 70 | ND | 1.19 | NC | 0.14 | 0.15 | 0.10 | 0.17 |
| Carbon Tetrachloride | 0.36 | 1.4 | 70 | ND | 0.02 | NC | 0.18 | 0.10 | 0.16 | 0.21 |
| Butyraldehyde | 0.25 | 1.4 | 70 | ND | 0.18 | NC | 0.13 | 0.07 | 0.11 | 0.14 |

# Table 4-3
## (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | Number of Observations | Minimum (ppm) | Maximum (ppm) | Median (ppm) | Average (ppm) | Standard Deviation (ppm) | 95% Confidence Intervals Lower (ppm) | 95% Confidence Intervals Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2-Butanone | 0.25 | 1.4 | 70 | ND | 5.63 | NC | 0.20 | 0.66 | 0.05 | 0.36 |
| 2-Methyl-1-Pentene | 0.25 | 1.4 | 70 | ND | 3.02 | NC | 0.16 | 0.35 | 0.08 | 0.25 |
| 1,1,2-Trichloroethane | 0.27 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| t-4-Methyl-2-Pentene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Vinyl Bromide | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Trichloroethylene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Methylcyclopentene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Indene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Freon 23 | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Ethylene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Dibromochloromethane | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Chloroform | 0.19 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Chlorodifluoromethane | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| p-Chlorotoluene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Bromoform | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Acrylonitrile | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| Acetaldehyde | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| 1-Propanol | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| 2,4-4-Trimethyl-2-Pentene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| 1-Nonene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |
| 1,3-Butadiene | 0.25 | 0.0 | 70 | ND | NC | NC | NC | NC | NC | NC |

ND = Not Detected
NC = Not Calculated

# Table 4-4
# Concentration and Emission Rate Measurements for Select VOCs from Section 2/8 Passive Vents

| Site ID | V-002 | | V-004 | | V-007 | | V-011 | | V-014 | | V-017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound Name** | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 1.16 | 46.9 | 2.51 | 113 | 3.23 | 111 | 0.89 | 25.1 | 1.77 | 86.9 | 4.74 | 250 |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | 0.05 | 4.1 |
| Methylene Chloride | 0.94 | 51.6 | 0.39 | 23.6 | 1.40 | 65.4 | 0.81 | 31.1 | 0.76 | 50.9 | 8.56 | 614 |
| 1,1-Dichloroethane | 1.26 | 80.8 | 0.75 | 53.9 | 2.07 | 113 | 0.66 | 29.7 | 1.11 | 86.1 | 4.35 | 364 |
| c-1,2-Dichloroethylene | 0.19 | 12.2 | 0.54 | 37.7 | 1.31 | 69.6 | 0.15 | 6.76 | 0.91 | 69.1 | 1.55 | 127 |
| 1,1,1-Trichloroethane | 0.10 | 8.71 | 0.11 | 10.2 | 0.29 | 21.2 | 0.07 | 4.43 | 0.34 | 35.8 | 0.40 | 44.5 |
| Benzene | 0.29 | 15.0 | 0.27 | 15.1 | 0.50 | 21.6 | 0.07 | 2.41 | 0.24 | 14.5 | 0.62 | 41.0 |
| Toluene | 6.16 | 368 | 8.95 | 596 | 30.45 | 1540 | 2.02 | 84.1 | 11.21 | 810 | 23.03 | 1790 |
| Chlorobenzene | 0.51 | 37.0 | 1.16 | 94.4 | 2.34 | 145 | 0.24 | 12.3 | 1.26 | 112 | 1.91 | 182 |
| Ethylbenzene | 0.64 | 43.8 | 1.12 | 86.0 | 4.51 | 263 | 0.10 | 5.03 | 1.24 | 103 | 2.17 | 195 |
| p-Xylene + m-Xylene | 1.25 | 86.4 | 1.70 | 131 | 7.96 | 464 | 0.39 | 18.8 | 2.48 | 207 | 4.47 | 401 |
| Styrene | 0.53 | 36.0 | 0.88 | 66.4 | 3.01 | 172 | 0.20 | 9.54 | 1.15 | 94.2 | 1.96 | 172 |
| o-Xylene | 0.51 | 35.1 | 0.58 | 44.5 | 2.56 | 150 | 0.19 | 9.34 | 0.78 | 65.2 | 1.86 | 167 |
| n-Nonane | 0.62 | 51.3 | 1.23 | 114 | 5.15 | 363 | 0.17 | 9.67 | 2.00 | 202 | 2.74 | 297 |
| n-Undecane | 0.10 | 9.71 | 0.20 | 22.7 | 1.05 | 90.3 | 0.05 | 3.45 | 0.18 | 21.9 | 0.45 | 58.9 |
| Benzyl Chloride & m-Dichlorobenzene | 0.17 | 14.7 | 0.32 | 32.1 | 1.05 | 79.2 | ND | NC | 0.48 | 51.5 | 0.41 | 47.1 |
| n-Decane & p-Dichlorobenzene | 0.88 | 82.2 | 1.27 | 132 | 7.44 | 591 | 0.32 | 21.1 | 2.40 | 273 | 3.27 | 400 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.35 | 28.5 | 0.54 | 49.6 | 1.90 | 133 | 0.11 | 6.40 | 0.81 | 81.1 | 1.29 | 139 |
| Trichloroethene | 0.12 | 9.87 | 0.27 | 26.0 | 0.77 | 55.6 | 0.19 | 11.5 | 0.96 | 99.3 | 2.71 | 300 |
| TNMHC | 154.30 | 8610 | 155.40 | 9660 | 375.80 | 17800 | 87.64 | 3400 | 195.00 | 13200 | 387.20 | 24500 |

# Table 4-4
# (Continued)

| Site ID<br>Compound Name | V-019 | | V-027 | | V-028 | | V-031 | | V-033 | | V-036 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 4.37 | 119 | 0.44 | 17.8 | 1.91 | 175 | 3.02 | 130 | 0.52 | 27.2 | 0.57 | 24.5 |
| 1,1-Dichloroethylene | 0.03 | 1.4 | ND | NC | ND | NC | 0.10 | 6.73 | ND | NC | ND | NC |
| Methylene Chloride | 11.08 | 409 | 1.04 | 56.8 | 10.85 | 1350 | 9.38 | 548 | 0.06 | 4.5 | 0.28 | 16.2 |
| 1,1-Dichloroethane | 3.65 | 157 | 0.56 | 35.6 | 2.57 | 373 | 4.34 | 296 | 0.23 | 18.8 | 0.29 | 19.4 |
| c-1,2-Dichloroethylene | 0.88 | 37.0 | 0.24 | 15.0 | 1.04 | 148 | 2.44 | 163 | 0.73 | 59.3 | 0.49 | 32.8 |
| 1,1,1-Trichloroethane | 0.45 | 26.0 | 0.22 | 19.1 | 0.40 | 79.1 | 0.43 | 39.4 | 0.03 | 3.4 | 0.11 | 9.74 |
| Benzene | 0.40 | 13.6 | 0.15 | 7.50 | 0.44 | 50.4 | 0.92 | 49.4 | 0.41 | 27.0 | 0.48 | 25.7 |
| Toluene | 13.03 | 522 | 6.88 | 410 | 19.98 | 2700 | 45.56 | 2890 | 20.17 | 1550 | 24.47 | 1550 |
| Chlorobenzene | 1.34 | 65.7 | 0.78 | 56.4 | 2.18 | 360 | 3.36 | 261 | 1.44 | 135 | 1.38 | 107 |
| Ethylbenzene | 1.01 | 46.6 | 1.35 | 92.9 | 2.80 | 436 | 5.30 | 387 | 6.73 | 596 | 7.28 | 530 |
| p-Xylene + m-Xylene | 2.10 | 97.0 | 2.84 | 195 | 4.78 | 743 | 7.90 | 578 | 9.67 | 856 | 9.83 | 716 |
| Styrene | 1.20 | 54.4 | 0.96 | 64.3 | 2.32 | 353 | 4.21 | 302 | 2.24 | 194 | 2.98 | 213 |
| o-Xylene | 1.48 | 68.4 | 0.94 | 64.4 | 1.98 | 307 | 1.93 | 141 | 3.36 | 298 | 3.37 | 246 |
| n-Nonane | 1.81 | 101 | 1.67 | 138 | 4.03 | 757 | 6.78 | 599 | 5.19 | 555 | 5.34 | 470 |
| n-Undecane | 0.25 | 17.1 | 0.56 | 57.0 | 0.90 | 206 | 1.02 | 110 | 3.65 | 475 | 4.60 | 493 |
| Benzyl Chloride & m-Dichlorobenzene | 0.33 | 19.7 | 0.27 | 23.9 | 1.21 | 242 | 0.52 | 48.6 | 1.01 | 115 | 1.15 | 108 |
| n-Decane & p-Dichlorobenzene | 2.09 | 131 | 4.46 | 416 | 6.79 | 1440 | 8.58 | 855 | 13.84 | 1670 | 17.96 | 1780 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.77 | 42.9 | 1.07 | 88.2 | 1.93 | 359 | 2.51 | 219 | 5.23 | 555 | 5.90 | 515 |
| Trichloroethene | 0.93 | 53.3 | 0.20 | 17.3 | 0.64 | 124 | 1.97 | 179 | 0.16 | 17.7 | 0.20 | 17.7 |
| TNMHC | 244.70 | 9160 | 151.10 | 8400 | 372.90 | 47000 | 509.20 | 30200 | 428.90 | 30800 | 543.00 | 32000 |

# Table 4-4
# (Continued)

| Site ID Compound Name | V-038 (ppm) | V-038 (ug/sec) | V-040 (ppm) | V-040 (ug/sec) | V-050 (ppm) | V-050 (ug/sec) | V-052 (ppm) | V-052 (ug/sec) | V-054 (ppm) | V-054 (ug/sec) | V-058 (ppm) | V-058 (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinyl Chloride | 2.42 | 60.8 | 0.98 | 29.5 | ND | NC | 1.02 | 64.1 | 1.54 | 32.2 | 5.01 | 54.3 |
| 1,1-Dichloroethylene | 0.02 | 0.850 | ND | NC | ND | NC | 0.08 | 7.63 | ND | NC | 0.05 | 0.810 |
| Methylene Chloride | 0.41 | 14.1 | ND | NC | ND | NC | 1.14 | 97.0 | 0.11 | 3.04 | 0.12 | 1.74 |
| 1,1-Dichloroethane | 0.58 | 23.0 | 0.13 | 5.96 | 0.06 | 2.95 | 1.38 | 137 | 0.46 | 15.2 | 0.19 | 3.21 |
| c-1,2-Dichloroethylene | 1.19 | 46.4 | 0.60 | 28.2 | ND | NC | 1.54 | 150 | 0.43 | 14.1 | 8.94 | 150 |
| 1,1,1-Trichloroethane | 0.07 | 4.01 | ND | NC | ND | NC | 0.41 | 55.1 | 0.13 | 5.85 | ND | NC |
| Benzene | 0.45 | 14.2 | 0.44 | 16.4 | 0.70 | 27.7 | 0.61 | 47.7 | 0.32 | 8.42 | 0.50 | 6.74 |
| Toluene | 22.30 | 825 | 24.79 | 1100 | 1.23 | 57.1 | 40.98 | 3800 | 28.21 | 869 | 43.59 | 695 |
| Chlorobenzene | 2.36 | 107 | 1.57 | 85.0 | 1.87 | 107 | 2.96 | 336 | 1.94 | 73.2 | 2.38 | 46.5 |
| Ethylbenzene | 6.73 | 287 | 7.66 | 392 | 8.59 | 462 | 6.84 | 731 | 7.39 | 263 | 16.43 | 302 |
| p-Xylene + m-Xylene | 8.00 | 341 | 11.69 | 598 | 9.09 | 488 | 10.17 | 1090 | 11.22 | 399 | 28.98 | 533 |
| Styrene | 2.66 | 111 | 2.13 | 107 | 1.58 | 83.1 | 5.10 | 534 | 3.56 | 124 | 4.20 | 75.7 |
| o-Xylene | 2.97 | 127 | 3.71 | 190 | 3.08 | 165 | 5.87 | 627 | 3.85 | 137 | 9.12 | 168 |
| n-Nonane | 5.93 | 306 | 5.01 | 309 | 4.21 | 273 | 6.99 | 903 | 6.58 | 283 | 9.62 | 214 |
| n-Undecane | 2.65 | 166 | 6.41 | 482 | 1.62 | 128 | 1.48 | 233 | 2.99 | 157 | 4.43 | 120 |
| Benzyl Chloride & m-Dichlorobenzene | 1.55 | 85.0 | 2.84 | 187 | 1.12 | 77.5 | 0.73 | 99.9 | 2.57 | 118 | 1.20 | 28.3 |
| n-Decane & p-Dichlorobenzene | 12.51 | 727 | 17.46 | 1220 | 1.40 | 103 | 12.04 | 1750 | 2.44 | 118 | 21.34 | 534 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.37 | 224 | 6.99 | 428 | 5.63 | 362 | 4.17 | 534 | 5.24 | 223 | 8.90 | 196 |
| Trichloroethene | 0.28 | 14.9 | 0.13 | 8.04 | ND | NC | 0.84 | 111 | 0.14 | 5.95 | 1.18 | 26.8 |
| TNMHC | 437.78 | 15100 | 511.80 | 21200 | 264.70 | 11500 | 612.00 | 52900 | 517.70 | 14900 | 649.10 | 9670 |

# Table 4-4
## (Continued)

| Site ID Compound Name | V-061 (ppm) | V-061 (ug/sec) | V-067 (ppm) | V-067 (ug/sec) | V-070 (ppm) | V-070 (ug/sec) | V-083 (ppm) | V-083 (ug/sec) | V-085 (ppm) | V-085 (ug/sec) | V-086 (ppm) | V-086 (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinyl Chloride | 0.33 | 14.2 | 2.31 | 195 | 5.33 | 201 | 4.04 | 139 | 1.61 | 95.5 | 1.87 | 97.2 |
| 1,1-Dichloroethylene | ND | NC | 0.06 | 8.35 | 0.07 | 3.89 | ND | NC | 0.07 | 6.64 | 0.04 | 2.91 |
| Methylene Chloride | ND | NC | 0.06 | 6.75 | 0.29 | 14.8 | 0.05 | 2.51 | 1.49 | 120 | 0.88 | 62.3 |
| 1,1-Dichloroethane | 0.06 | 4.31 | 0.33 | 43.5 | 0.24 | 14.2 | 0.12 | 6.78 | 1.73 | 163 | 1.23 | 101 |
| c-1,2-Dichloroethylene | 0.05 | 3.65 | 0.55 | 72.4 | 6.03 | 353 | 1.13 | 60.3 | 2.17 | 200 | 2.29 | 185 |
| 1,1,1-Trichloroethane | ND | NC | 0.09 | 15.3 | 0.13 | 10.9 | ND | NC | 0.29 | 36.4 | 0.10 | 11.3 |
| Benzene | 0.53 | 29.1 | 0.37 | 38.7 | 0.51 | 24.2 | 0.62 | 26.6 | 1.18 | 87.9 | 0.54 | 35.3 |
| Toluene | 7.23 | 464 | 23.99 | 2980 | 56.38 | 3140 | 28.37 | 1440 | 39.82 | 3490 | 30.83 | 2370 |
| Chlorobenzene | 2.40 | 188 | 2.35 | 357 | 3.55 | 242 | 2.03 | 126 | 3.12 | 334 | 2.72 | 255 |
| Ethylbenzene | 7.95 | 588 | 8.19 | 1170 | 14.62 | 939 | 14.10 | 824 | 7.10 | 717 | 6.87 | 608 |
| p-Xylene + m-Xylene | 8.51 | 630 | 10.75 | 1540 | 30.15 | 1940 | 20.06 | 1170 | 10.87 | 1100 | 9.50 | 841 |
| Styrene | 1.92 | 139 | 2.96 | 415 | 6.49 | 409 | 2.73 | 156 | 5.41 | 536 | 4.93 | 427 |
| o-Xylene | 3.45 | 255 | 3.93 | 563 | 14.76 | 948 | 6.61 | 386 | 3.36 | 339 | 4.01 | 355 |
| n-Nonane | 5.04 | 451 | 6.56 | 1140 | 10.34 | 802 | 7.72 | 545 | 7.88 | 960 | 7.44 | 794 |
| n-Undecane | 2.95 | 322 | 2.48 | 523 | 4.02 | 380 | 4.19 | 360 | 2.06 | 306 | 2.34 | 305 |
| Benzyl Chloride & m-Dichlorobenzene | 1.81 | 172 | 0.93 | 172 | 3.74 | 309 | 2.78 | 209 | 0.66 | 85.2 | 2.56 | 291 |
| n-Decane & p-Dichlorobenzene | 11.78 | 1190 | 12.53 | 2440 | 20.50 | 1790 | 20.07 | 1600 | 13.65 | 1880 | 14.39 | 1730 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.99 | 443 | 4.65 | 797 | 9.24 | 711 | 8.01 | 560 | 4.00 | 483 | 5.89 | 624 |
| Trichloroethene | ND | NC | 0.20 | 36.0 | 1.51 | 120 | 0.14 | 10.3 | 1.08 | 135 | 0.73 | 79.7 |
| TNMHC | 328.20 | 19700 | 480.23 | 55700 | 1046.00 | 54400 | 514.10 | 24300 | 645.20 | 52700 | 648.00 | 46400 |

# Table 4-4
## (Continued)

| Site ID<br>Compound Name | V-087 (ppm) | V-087 (ug/sec) | V-092 (ppm) | V-092 (ug/sec) | V-096 (ppm) | V-096 (ug/sec) | V-099 (ppm) | V-099 (ug/sec) | V-100 (ppm) | V-100 (ug/sec) | V-103 (ppm) | V-103 (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinyl Chloride | 1.58 | 124 | 3.78 | 72.2 | 2.62 | 121 | 6.69 | 49.9 | 4.26 | 115 | 3.15 | 177 |
| 1,1-Dichloroethylene | ND | NC | 0.07 | 2.07 | 0.06 | 4.19 | 0.07 | 0.87 | ND | NC | 0.02 | 2.02 |
| Methylene Chloride | 1.48 | 158 | 0.35 | 9.10 | 3.14 | 196 | 0.06 | 0.64 | 0.08 | 2.90 | 1.21 | 92.6 |
| 1,1-Dichloroethane | 1.15 | 144 | 0.15 | 4.50 | 2.38 | 174 | 0.16 | 1.84 | 0.11 | 4.78 | 0.62 | 55.5 |
| c-1,2-Dichloroethylene | 0.88 | 108 | 3.48 | 103 | 1.70 | 121 | 3.17 | 36.7 | 2.67 | 112 | 2.01 | 175 |
| 1,1,1-Trichloroethane | 0.11 | 18.1 | 0.09 | 3.76 | 0.66 | 64.5 | ND | NC | 0.03 | 1.49 | 0.13 | 15.1 |
| Benzene | 0.36 | 35.5 | 0.55 | 13.1 | 0.69 | 39.8 | 0.54 | 5.00 | 0.62 | 21.1 | 0.49 | 34.3 |
| Toluene | 21.39 | 2490 | 48.05 | 1350 | 32.45 | 2200 | 54.46 | 599 | 32.20 | 1290 | 32.81 | 2720 |
| Chlorobenzene | 1.77 | 251 | 2.44 | 84.0 | 2.68 | 222 | 2.82 | 38.0 | 3.81 | 186 | 2.19 | 222 |
| Ethylbenzene | 3.63 | 486 | 13.88 | 451 | 6.98 | 546 | 13.88 | 176 | 11.35 | 522 | 9.59 | 916 |
| p-Xylene + m-Xylene | 5.91 | 791 | 28.82 | 936 | 10.20 | 797 | 24.80 | 315 | 16.75 | 771 | 16.32 | 1560 |
| Styrene | 2.48 | 325 | 4.74 | 151 | 4.26 | 326 | 3.20 | 39.8 | 2.80 | 126 | 3.42 | 321 |
| o-Xylene | 1.90 | 255 | 8.20 | 266 | 4.46 | 349 | 6.97 | 88.4 | 4.61 | 212 | 5.72 | 546 |
| n-Nonane | 4.48 | 725 | 8.74 | 343 | 7.33 | 692 | 9.79 | 150 | 8.13 | 452 | 7.17 | 827 |
| n-Undecane | 1.19 | 234 | 1.16 | 55.2 | 2.36 | 271 | 2.41 | 45.0 | 1.29 | 87.2 | 3.66 | 515 |
| Benzyl Chloride & m-Dichlorobenzene | 0.44 | 75.5 | 1.89 | 79.1 | 2.23 | 225 | 2.18 | 35.6 | 1.28 | 76.2 | 1.74 | 215 |
| n-Decane & p-Dichlorobenzene | 8.07 | 1470 | 12.04 | 532 | 13.65 | 1450 | 14.66 | 253 | 9.70 | 613 | 16.45 | 2140 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 1.86 | 299 | 3.92 | 152 | 4.82 | 451 | 5.46 | 82.9 | 2.91 | 161 | 6.58 | 753 |
| Trichloroethene | 0.42 | 69.2 | 0.96 | 38.5 | 0.91 | 87.6 | 0.59 | 9.29 | 0.28 | 15.8 | 0.46 | 54.8 |
| TNMHC | 316.70 | 34300 | 508.80 | 13400 | 536.10 | 33900 | 533.40 | 5480 | 366.60 | 13700 | 537.20 | 41600 |

# Table 4-4
# (Continued)

| Site ID Compound Name | V-107 (ppm) | V-107 (ug/sec) | V-112 (ppm) | V-112 (ug/sec) |
|---|---|---|---|---|
| Vinyl Chloride | 2.66 | 123 | 5.68 | 117 |
| 1,1-Dichloroethylene | 0.03 | 2.42 | 0.06 | 2.07 |
| Methylene Chloride | 0.80 | 50.1 | 0.19 | 5.29 |
| 1,1-Dichloroethane | 0.78 | 56.9 | 0.15 | 4.86 |
| c-1,2-Dichloroethylene | 3.80 | 272 | 7.66 | 245 |
| 1,1,1-Trichloroethane | 0.23 | 23.2 | 0.07 | 3.26 |
| Benzene | 0.66 | 38.0 | 0.38 | 9.69 |
| Toluene | 44.86 | 3060 | 38.71 | 1180 |
| Chlorobenzene | 2.96 | 247 | 1.93 | 72.0 |
| Ethylbenzene | 11.73 | 922 | 8.36 | 294 |
| p-Xylene + m-Xylene | 22.83 | 1790 | 15.00 | 527 |
| Styrene | 5.19 | 400 | 2.82 | 97.1 |
| o-Xylene | 8.71 | 685 | 4.08 | 143 |
| n-Nonane | 9.16 | 869 | 5.45 | 231 |
| n-Undecane | 2.88 | 333 | 1.29 | 66.5 |
| Benzyl Chloride & m-Dichlorobenzene | 2.35 | 238 | 0.39 | 17.6 |
| n-Decane & p-Dichlorobenzene | 18.42 | 1970 | 8.18 | 391 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 6.22 | 585 | 3.22 | 136 |
| Trichloroethene | 0.93 | 90.9 | 0.85 | 37.1 |
| TNMHC | 659.98 | 42000 | 371.10 | 10600 |

ND = Not Detected
NC = Not Calculated

# Table 4-5
## Concentration and Emission Rate Measurements for Select VOCs from Section 3/4 Passive Vents

| Site ID / Compound Name | V-009 | | V-013 | | V-017 | | V-020 | | V-022 | | V-027 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 2.13 | 89.8 | 1.70 | 101.3 | 2.05 | 114.7 | 1.94 | 75.9 | ND | ND | 1.14 | 24.4 |
| 1,1-Dichloroethylene | ND | NC | 0.03 | 2.74 | ND | NC | ND | NC | 0.03 | 3.74 | ND | NC |
| Methylene Chloride | 0.05 | 3.05 | 0.17 | 14.0 | 0.05 | 3.92 | ND | NC | 0.18 | 20.8 | 0.05 | 1.44 |
| 1,1-Dichloroethane | 0.28 | 18.9 | 0.39 | 37.0 | 0.34 | 30.4 | ND | NC | 0.38 | 51.6 | 0.04 | 1.42 |
| c-1,2-Dichloroethylene | 0.25 | 16.4 | 0.62 | 57.3 | 0.44 | 37.8 | 0.26 | 15.7 | 0.58 | 76.7 | 0.21 | 6.95 |
| 1,1,1-Trichloroethane | 0.02 | 1.86 | 0.04 | 5.48 | 0.10 | 12.3 | ND | NC | 0.06 | 11.1 | 0.04 | 1.98 |
| Benzene | 0.52 | 27.3 | 0.72 | 53.5 | 0.36 | 25.0 | 0.81 | 39.5 | 0.73 | 77.2 | 0.57 | 15.2 |
| Toluene | 11.33 | 705 | 24.77 | 2180 | 17.56 | 1450 | 17.14 | 986 | 29.46 | 3680 | 11.68 | 367 |
| Chlorobenzene | 2.05 | 156 | 2.77 | 298 | 2.32 | 235 | 1.63 | 115 | 2.90 | 443 | 1.63 | 62.8 |
| Ethylbenzene | 5.68 | 407 | 10.42 | 1060 | 6.33 | 602 | 13.37 | 887 | 11.10 | 1600 | 5.88 | 213 |
| p-Xylene + m-Xylene | 7.08 | 508 | 15.53 | 1580 | 7.78 | 740 | 18.42 | 1220 | 14.45 | 2080 | 12.03 | 437 |
| Styrene | 1.86 | 131 | 3.05 | 303 | 1.80 | 168 | 1.81 | 118 | 3.40 | 481 | 2.06 | 73.3 |
| o-Xylene | 3.06 | 220 | 5.74 | 583 | 2.74 | 261 | 6.77 | 449 | 6.30 | 908 | 4.64 | 168 |
| n-Nonane | 4.80 | 415 | 8.21 | 1010 | 5.57 | 641 | 7.62 | 610 | 10.20 | 1780 | 6.00 | 263 |
| n-Undecane | 1.78 | 187 | 3.01 | 450 | 2.09 | 293 | 3.89 | 380 | 3.83 | 813 | 2.50 | 134 |
| Benzyl Chloride & m-Dichlorobenzene | 1.56 | 144 | 3.55 | 465 | 1.52 | 186 | 2.82 | 241 | 3.67 | 681 | 2.23 | 104 |
| n-Decane & p-Dichlorobenzene | 8.97 | 876 | 17.63 | 2440 | 10.25 | 1330 | 21.53 | 1940 | 21.51 | 4220 | 14.75 | 728 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 3.50 | 300 | 7.62 | 927 | 3.31 | 377 | 9.29 | 738 | 6.71 | 1160 | 5.17 | 225 |
| Trichloroethene | 0.08 | 6.73 | 0.46 | 58.1 | 0.14 | 16.5 | 0.03 | 2.08 | 0.27 | 47.6 | 0.03 | 1.24 |
| TNMHC | 303.10 | 17600 | 561.50 | 46200 | 344.70 | 26600 | 486.83 | 26200 | 655.30 | 76500 | 390.40 | 11500 |

# Table 4-5
## (Continued)

| Site ID / Compound Name | V-028 | | V-034 | | V-039 | | V-045 | | V-052 | | V-055 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 1.93 | 171 | 2.43 | 98.8 | 11.01 | 120 | 2.31 | 118 | 1.81 | 97.8 | 6.74 | 650 |
| 1,1-Dichloroethylene | ND | NC | ND | NC | 0.07 | 1.15 | 0.10 | 8.00 | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | 0.05 | 2.90 | 0.08 | 1.13 | 0.16 | 11.2 | 0.06 | 4.10 | ND | NC |
| 1,1-Dichloroethane | 0.53 | 75.0 | 0.15 | 9.59 | 0.10 | 1.71 | 0.70 | 56.6 | 0.24 | 20.4 | 0.06 | 9.74 |
| c-1,2-Dichloroethylene | 0.34 | 46.7 | 0.82 | 51.8 | 4.34 | 73.0 | 1.64 | 130 | 0.31 | 26.1 | 0.48 | 71.1 |
| 1,1,1-Trichloroethane | 0.38 | 72.1 | 0.06 | 4.94 | ND | NC | 0.40 | 43.8 | 0.04 | 4.42 | ND | NC |
| Benzene | 0.43 | 47.6 | 0.87 | 43.9 | 0.59 | 7.94 | 0.72 | 45.8 | 0.42 | 28.1 | 0.47 | 56.2 |
| Toluene | 19.22 | 2520 | 27.87 | 1670 | 41.71 | 668 | 35.73 | 2690 | 22.22 | 1770 | 27.44 | 3900 |
| Chlorobenzene | 2.21 | 354 | 2.72 | 199 | 3.01 | 58.9 | 3.73 | 344 | 2.17 | 211 | 2.48 | 432 |
| Ethylbenzene | 7.79 | 1180 | 14.07 | 970 | 13.55 | 250 | 11.16 | 970 | 10.44 | 958 | 9.98 | 1630 |
| p-Xylene + m-Xylene | 9.72 | 1470 | 24.81 | 1710 | 24.50 | 452 | 15.94 | 1380 | 12.99 | 1190 | 18.28 | 3000 |
| Styrene | 2.18 | 323 | 3.22 | 218 | 3.08 | 55.8 | 5.70 | 485 | 2.82 | 254 | 2.46 | 394 |
| o-Xylene | 3.59 | 542 | 9.14 | 630 | 7.46 | 138 | 5.42 | 471 | 5.06 | 465 | 6.54 | 1070 |
| n-Nonane | 7.04 | 1280 | 11.63 | 969 | 10.92 | 243 | 11.42 | 1200 | 8.75 | 970 | 10.55 | 2090 |
| n-Undecane | 2.86 | 636 | 4.91 | 498 | 2.12 | 57.5 | 4.76 | 609 | 3.74 | 505 | 1.61 | 388 |
| Benzyl Chloride & m-Dichlorobenzene | 2.59 | 503 | 1.62 | 144 | 2.13 | 50.6 | 3.47 | 389 | 2.67 | 316 | 0.73 | 155 |
| n-Decane & p-Dichlorobenzene | 14.51 | 2980 | 26.68 | 2690 | 14.94 | 375 | 21.36 | 2530 | 19.15 | 2390 | 15.54 | 3240 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.97 | 899 | 10.19 | 841 | 5.37 | 119 | 8.21 | 855 | 5.53 | 608 | 4.98 | 977 |
| Trichloroethene | 0.11 | 21.5 | 0.13 | 11.4 | 0.75 | 17.2 | 0.97 | 104 | 0.11 | 12.9 | ND | NC |
| TNMHC | 420.40 | 51400 | 803.00 | 44800 | 499.30 | 7460 | 862.20 | 60700 | 545.70 | 40600 | 440.60 | 58500 |

# Table 4-5
# (Continued)

| Site ID<br>Compound Name | V-060 | | V-068 | | V-070 | | V-075 | | V-076 | | V-083 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 3.25 | 155 | 0.61 | 37.2 | 1.10 | 26.4 | 2.96 | 117 | 2.02 | 210 | 0.81 | 32.2 |
| 1,1-Dichloroethylene | 0.02 | 1.57 | ND | NC | ND | NC | ND | NC | ND | NC | 0.06 | 3.76 |
| Methylene Chloride | 0.19 | 12.5 | ND | NC | ND | NC | 0.06 | 3.24 | ND | NC | 0.06 | 3.02 |
| 1,1-Dichloroethane | 0.61 | 46.4 | 0.13 | 12.4 | 0.04 | 1.33 | 0.42 | 26.4 | 0.27 | 45.0 | 0.31 | 19.8 |
| c-1,2-Dichloroethylene | 0.81 | 59.6 | 0.13 | 12.0 | 0.04 | 1.36 | 0.66 | 40.1 | 0.28 | 44.6 | 0.24 | 14.7 |
| 1,1,1-Trichloroethane | 0.14 | 14.3 | 0.10 | 13.2 | ND | NC | 0.13 | 10.5 | 0.02 | 4.74 | 0.17 | 14.6 |
| Benzene | 0.80 | 47.7 | 0.46 | 35.2 | 0.48 | 14.4 | 0.65 | 32.3 | 0.27 | 35.0 | 0.30 | 15.2 |
| Toluene | 41.21 | 2890 | 11.75 | 1050 | 10.48 | 370 | 39.65 | 2300 | 13.98 | 2150 | 11.21 | 660 |
| Chlorobenzene | 4.57 | 392 | 2.32 | 254 | 1.43 | 61.7 | 3.56 | 253 | 1.60 | 299 | 1.26 | 90.5 |
| Ethylbenzene | 14.36 | 1160 | 6.73 | 696 | 10.84 | 441 | 11.48 | 770 | 6.15 | 1090 | 4.38 | 297 |
| p-Xylene + m-Xylene | 19.71 | 1600 | 8.76 | 906 | 13.53 | 551 | 14.87 | 997 | 7.32 | 1300 | 5.75 | 390 |
| Styrene | 4.89 | 388 | 2.01 | 204 | 1.21 | 48.2 | 3.57 | 235 | 1.54 | 268 | 1.66 | 110 |
| o-Xylene | 5.54 | 448 | 4.09 | 424 | 5.32 | 217 | 4.10 | 275 | 2.44 | 432 | 2.31 | 157 |
| n-Nonane | 15.49 | 1510 | 5.78 | 722 | 5.71 | 281 | 10.78 | 873 | 5.04 | 1080 | 3.55 | 291 |
| n-Undecane | 3.18 | 379 | 3.91 | 595 | 6.12 | 367 | 2.02 | 199 | 3.31 | 862 | 2.11 | 210 |
| Benzyl Chloride & m-Dichlorobenzene | 3.82 | 398 | 1.88 | 251 | 2.08 | 109 | 2.54 | 220 | 2.14 | 487 | 0.70 | 61.6 |
| n-Decane & p-Dichlorobenzene | 20.61 | 2270 | 15.96 | 2250 | 19.98 | 1110 | 15.77 | 1440 | 12.03 | 2900 | 9.28 | 857 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 7.01 | 680 | 7.28 | 902 | 11.26 | 549 | 4.63 | 371 | 4.55 | 965 | 3.59 | 291 |
| Trichloroethene | 0.53 | 52.7 | 0.03 | 4.03 | ND | NC | 0.23 | 18.8 | 0.04 | 8.43 | 0.08 | 6.30 |
| TNMHC | 707.80 | 46400 | 447.70 | 37500 | 430.10 | 14200 | 557.20 | 30200 | 331.10 | 47500 | 293.70 | 16100 |

# Table 4-5
## (Continued)

| Site ID<br>Compound Name | V-089 | | V-093N | | V-097 | | V-106 | | V-110 | | V-113 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | ND | NC | 1.51 | 23.5 | 2.04 | 47.9 | 0.85 | 8.35 | ND | NC | 0.75 | 52.4 |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | 0.12 | 2.52 | ND | NC | 0.12 | 1.66 | ND | NC | ND | NC |
| 1,1-Dichloroethane | 0.23 | 14.3 | 0.28 | 6.84 | 0.34 | 12.7 | 0.22 | 3.44 | ND | NC | 0.13 | 14.6 |
| c-1,2-Dichloroethylene | 0.69 | 42.6 | 0.56 | 13.5 | 0.34 | 12.4 | 0.15 | 2.24 | 0.07 | 6.81 | 0.12 | 12.7 |
| 1,1,1-Trichloroethane | 0.08 | 6.54 | 0.15 | 5.10 | 0.02 | 1.08 | 0.04 | 0.83 | ND | NC | 0.04 | 6.09 |
| Benzene | 0.67 | 33.5 | 0.14 | 2.65 | 0.84 | 24.7 | 0.08 | 0.99 | 0.20 | 16.0 | 0.50 | 43.7 |
| Toluene | 16.58 | 975 | 7.73 | 176 | 9.90 | 342 | 1.06 | 15.3 | 1.30 | 123 | 11.80 | 1220 |
| Chlorobenzene | 3.16 | 227 | 1.77 | 49.3 | 2.98 | 126 | 1.05 | 18.6 | 1.02 | 119 | 1.88 | 237 |
| Ethylbenzene | 11.29 | 766 | 2.23 | 58.8 | 11.33 | 452 | 1.80 | 30.0 | 1.22 | 134 | 8.54 | 1010 |
| p-Xylene + m-Xylene | 10.99 | 746 | 3.31 | 87.1 | 12.89 | 514 | 1.03 | 17.2 | 2.13 | 233 | 11.36 | 1350 |
| Styrene | 2.83 | 188 | 1.59 | 40.9 | 3.12 | 122 | 0.71 | 11.7 | 0.92 | 98.9 | 1.53 | 178 |
| o-Xylene | 4.22 | 287 | 1.20 | 31.7 | 5.12 | 204 | 0.61 | 10.1 | 1.11 | 122 | 4.52 | 537 |
| n-Nonane | 7.69 | 631 | 3.40 | 108 | 9.65 | 465 | 0.70 | 14.1 | 1.30 | 173 | 6.37 | 915 |
| n-Undecane | 3.47 | 346 | 0.64 | 24.6 | 4.90 | 287 | 0.18 | 4.49 | 0.26 | 42.3 | 5.42 | 947 |
| Benzyl Chloride & m-Dichlorobenzene | 3.38 | 295 | 0.27 | 9.04 | 3.86 | 198 | 0.17 | 3.65 | 1.45 | 204 | 1.83 | 280 |
| n-Decane & p-Dichlorobenzene | 17.20 | 1590 | 5.47 | 196 | 23.69 | 1290 | 1.07 | 24.2 | 2.99 | 447 | 22.94 | 3710 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 7.88 | 641 | 1.27 | 39.9 | 7.86 | 376 | 0.93 | 18.5 | 2.03 | 267 | 8.86 | 1260 |
| Trichloroethene | 0.16 | 13.3 | 0.16 | 5.29 | 0.07 | 3.42 | 0.19 | 3.83 | ND | NC | ND | NC |
| TNMHC | 529.30 | 29100 | 210.30 | 4480 | 540.08 | 17400 | 154.90 | 2090 | 163.00 | 14500 | 498.40 | 48000 |

# Table 4-5
# (Continued)

| Site ID / Compound Name | V-118 (ppm) | V-118 (ug/sec) | V-120 (ppm) | V-120 (ug/sec) | V-121 (ppm) | V-121 (ug/sec) | V-123 (ppm) | V-123 (ug/sec) | V-131 (ppm) | V-131 (ug/sec) | V-133 (ppm) | V-133 (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vinyl Chloride | 0.61 | 38.2 | ND | NC | 0.35 | 3.07 | 0.73 | 14.6 | 0.26 | 2.07 | 0.79 | 34.7 |
| 1,1-Dichloroethylene | 0.06 | 5.71 | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | ND | NC | 0.04 | 0.54 | ND | NC | ND | NC | ND | NC |
| 1,1-Dichloroethane | 0.12 | 12.3 | 0.03 | 1.87 | 0.15 | 2.09 | ND | NC | 0.06 | 0.72 | 0.17 | 12.1 |
| c-1,2-Dichloroethylene | 0.15 | 14.6 | ND | NC | 0.32 | 4.32 | ND | NC | ND | NC | 0.10 | 7.13 |
| 1,1,1-Trichloroethane | 0.05 | 6.20 | 0.01 | 1.12 | 0.03 | 0.65 | 0.05 | 2.29 | 0.06 | 0.98 | 0.06 | 5.77 |
| Benzene | 0.58 | 44.7 | 0.63 | 31.1 | 0.66 | 7.27 | 1.06 | 26.5 | 0.16 | 1.59 | 0.16 | 8.91 |
| Toluene | 11.72 | 1070 | 0.19 | 11.0 | 13.72 | 179 | 20.47 | 602 | 1.72 | 19.9 | 3.66 | 238 |
| Chlorobenzene | 1.89 | 212 | 2.06 | 147 | 2.22 | 35.4 | 2.60 | 93.5 | 1.53 | 21.6 | 1.73 | 138 |
| Ethylbenzene | 10.03 | 1060 | 0.31 | 21.2 | 9.54 | 144 | 11.21 | 380 | 1.24 | 16.6 | 1.65 | 124 |
| p-Xylene + m-Xylene | 11.07 | 1170 | 0.26 | 17.8 | 11.41 | 172 | 13.94 | 473 | 1.62 | 21.7 | 2.42 | 182 |
| Styrene | 2.00 | 207 | 2.73 | 180 | 2.34 | 34.4 | 2.84 | 94.4 | 1.44 | 18.8 | 1.53 | 113 |
| o-Xylene | 4.27 | 451 | 0.32 | 21.8 | 4.57 | 68.7 | 4.97 | 169 | 1.03 | 13.7 | 1.50 | 112 |
| n-Nonane | 7.25 | 924 | 1.10 | 89.5 | 7.18 | 130 | 8.59 | 352 | 2.99 | 48.2 | 2.76 | 250 |
| n-Undecane | 3.18 | 494 | 0.65 | 64.9 | 4.37 | 96.8 | 7.55 | 377 | 0.38 | 7.48 | 1.01 | 112 |
| Benzyl Chloride & m-Dichlorobenzene | 1.16 | 158 | 2.51 | 218 | 1.27 | 24.6 | 4.23 | 185 | 0.32 | 5.45 | 1.38 | 133 |
| n-Decane & p-Dichlorobenzene | 19.49 | 2800 | 1.70 | 156 | 20.29 | 415 | 25.74 | 1190 | 3.36 | 61.0 | 4.86 | 496 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 6.16 | 779 | 3.07 | 248 | 7.16 | 129 | 8.37 | 340 | 1.41 | 22.5 | 3.60 | 323 |
| Trichloroethene | 0.04 | 5.60 | ND | NC | 0.09 | 1.68 | ND | NC | ND | NC | 0.04 | 3.38 |
| TNMHC | 456.40 | 39000 | 229.00 | 12500 | 478.40 | 5830 | 558.70 | 15300 | 170.10 | 1840 | 255.30 | 15500 |

# Table 4-5
## (Continued)

| Site ID<br>Compound Name | V-134 | | V-139 | |
|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 0.26 | 1.52 | 0.10 | 1.23 |
| 1,1-Dichloroethylene | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | ND | NC |
| 1,1-Dichloroethane | ND | NC | ND | NC |
| c-1,2-Dichloroethylene | 0.05 | 0.42 | 0.21 | 4.13 |
| 1,1,1-Trichloroethane | ND | NC | ND | NC |
| Benzene | 0.10 | 0.70 | ND | NC |
| Toluene | 1.27 | 10.9 | 0.09 | 1.71 |
| Chlorobenzene | 1.13 | 11.9 | 0.36 | 8.14 |
| Ethylbenzene | 0.92 | 9.15 | 0.13 | 2.81 |
| p-Xylene + m-Xylene | 1.32 | 13.1 | 0.03 | 0.75 |
| Styrene | 0.70 | 6.81 | 0.26 | 5.49 |
| o-Xylene | 0.63 | 6.24 | 0.19 | 4.05 |
| n-Nonane | 0.77 | 9.23 | 0.21 | 5.47 |
| n-Undecane | 0.16 | 2.31 | 0.08 | 2.47 |
| Benzyl Chloride & m-Dichlorobenzene | 0.48 | 6.14 | ND | NC |
| n-Decane & p-Dichlorobenzene | 1.41 | 19.1 | 0.19 | 5.67 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 1.52 | 18.1 | 0.26 | 6.59 |
| Trichloroethene | 0.03 | 0.36 | 0.11 | 3.03 |
| TNMHC | 138.80 | 1120 | 63.85 | 1110 |

ND = Not Detected
NC = Not Calculated

# Table 4-6
## Concentration and Emission Rate Measurements for Select VOCs from Section 1/9 Passive Vents

| Site ID | V-902 | | V-906 | | V-914 | | V-916 | | V-919 | | V-934 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compound Name | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 0.19 | 4.33 | 0.14 | 1.82 | ND | NC | 0.29 | 4.20 | 0.07 | 1.31 | ND | NC |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| 1,1-Dichloroethane | 0.02 | 0.62 | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| c-1,2-Dichloroethylene | 0.05 | 1.69 | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| 1,1,1-Trichloroethane | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Benzene | 0.72 | 20.5 | 1.46 | 23.8 | 0.99 | 16.6 | 0.93 | 17.1 | 0.44 | 10.4 | 0.86 | 3.50 |
| Toluene | 2.87 | 96.5 | 2.24 | 42.9 | 1.6 | 31.6 | 1.03 | 22.2 | 1.35 | 37.8 | 0.26 | 1.26 |
| Chlorobenzene | 1.22 | 50.0 | 2.00 | 46.7 | 1.44 | 34.9 | 1.64 | 43.4 | 0.76 | 25.9 | 0.73 | 4.30 |
| Ethylbenzene | 5.64 | 218 | 7.29 | 161 | 4.65 | 106 | 4.44 | 110 | 2.12 | 68.6 | 1.16 | 6.46 |
| p-Xylene + m-Xylene | 7.38 | 286 | 8.35 | 184 | 4.63 | 106 | 4.78 | 119 | 3.11 | 101 | 0.95 | 5.29 |
| Styrene | 1.16 | 44.0 | 1.22 | 26.3 | 0.88 | 19.7 | 0.96 | 23.4 | 0.48 | 15.2 | 0.38 | 2.06 |
| o-Xylene | 3.06 | 119 | 3.07 | 67.7 | 2.05 | 46.7 | 1.98 | 49.3 | 1.23 | 40.0 | 0.60 | 3.33 |
| n-Nonane | 5.61 | 263 | 5.53 | 147 | 2.95 | 81.2 | 2.62 | 78.8 | 2.14 | 83.8 | 0.55 | 3.70 |
| n-Undecane | 4.26 | 243 | 3.32 | 108 | 2.76 | 92.3 | 2.19 | 80.1 | 1.23 | 58.5 | 0.62 | 5.06 |
| Benzyl Chloride & m-Dichlorobenzene | 2.45 | 122 | 3.04 | 86.4 | 1.44 | 42.2 | 1.56 | 50.1 | 1.56 | 65.1 | 0.62 | 4.40 |
| n-Decane & p-Dichlorobenzene | 16.94 | 894 | 16.51 | 496 | 13.39 | 416 | 12.06 | 408 | 8.63 | 380 | 2.84 | 21.5 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 5.13 | 238 | 6.09 | 161 | 5.82 | 159 | 6.04 | 180 | 2.84 | 110 | 2.33 | 15.5 |
| Trichloroethene | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| TNMHC | 332.00 | 10400 | 333.70 | 5970 | 327.00 | 6040 | 308.80 | 6220 | 180.00 | 4710 | 153.80 | 691 |

ND = Not Detected
NC = Not Calculated

# Table 4-7
## Concentration and Emission Rates of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Section 2/8 Passive Vents

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-001 | 2.41 | 77.6 | 2.7 | 0.06 | 1.5 | 0.01 | 18.3 | 0.27 | 1.21 | 1.9 | NM | NM |
| V-002 | 33.7 | 86.9 | 23.5 | 6.71 | 27.0 | 2.80 | 9.5 | 1.97 | 1.60 | 35.4 | NM | NM |
| V-004 | 37.5 | 91.3 | 22.2 | 7.06 | 29.4 | 3.40 | 7.8 | 1.81 | 1.20 | 29.6 | 0.13 | 18.9 |
| V-005 | 40.0 | 82.3 | 44.5 | 15.1 | 58.1 | 7.16 | 0.3 | 0.07 | 29.00 | 761.0 | 0.99 | 153.0 |
| V-007 | 28.5 | 80.8 | 43.2 | 10.4 | 59.0 | 5.19 | 0.5 | 0.09 | 24.65 | 461.3 | NM | NM |
| V-009 | 21.3 | 87.3 | 11.5 | 2.07 | 14.2 | 0.93 | 14.0 | 1.84 | 1.25 | 17.5 | NM | NM |
| V-011 | 23.4 | 86.1 | 8.0 | 1.59 | 9.3 | 0.67 | 15.9 | 2.30 | 0.29 | 4.5 | 0.23 | 20.8 |
| V-014 | 40.7 | 87.1 | 34.2 | 11.8 | 46.9 | 5.89 | 3.8 | 0.95 | 3.80 | 101.6 | NM | NM |
| V-016 | 25.9 | 89.5 | 13.8 | 3.02 | 19.4 | 1.55 | 13.4 | 2.14 | 1.40 | 23.8 | NM | NM |
| V-017 | 43.9 | 82.3 | 40.1 | 14.9 | 53.6 | 7.25 | 1.6 | 0.43 | 7.60 | 218.7 | 0.05 | 8.5 |
| V-018 | 6.23 | 85.2 | 31.0 | 1.64 | 41.7 | 0.80 | 5.1 | 0.20 | 1.40 | 5.7 | NM | NM |
| V-019 | 22.6 | 78.0 | 30.2 | 5.78 | 40.6 | 2.83 | 6.0 | 0.84 | 4.50 | 66.7 | NM | NM |
| V-025 | 27.6 | 86.1 | 7.8 | 1.82 | 9.7 | 0.82 | 16.6 | 2.82 | 47.40 | 856.9 | NM | NM |
| V-027 | 33.5 | 92.3 | 17.9 | 5.09 | 21.8 | 2.25 | 10.9 | 2.25 | 1.45 | 31.9 | 0.40 | 51.9 |
| V-028 | 76.0 | NM | 41.7 | 26.9 | 51.5 | 12.1 | 0.7 | 0.33 | 16.00 | 798.3 | NM | NM |
| V-031 | 35.8 | 83.9 | 44.4 | 13.5 | 61.5 | 6.78 | 0.0 | 0 | 41.00 | 961.8 | NM | NM |
| V-032 | 22.8 | 87.5 | 41.3 | 8.00 | 57.2 | 4.03 | 0.8 | 0.11 | 10.30 | 154.4 | NM | NM |
| V-033 | 43.3 | 85.4 | 43.2 | 15.9 | 61.1 | 8.15 | 0.0 | 0 | 43.00 | 1221.5 | NM | NM |
| V-034 | 30.3 | 83.7 | 43.7 | 11.2 | 64.9 | 6.07 | 0.0 | 0 | 18.00 | 358.4 | NM | NM |
| V-035 | 12.4 | 78.8 | 41.5 | 4.36 | 59.1 | 2.26 | 0.0 | 0 | 53.20 | 432.5 | NM | NM |
| V-036 | 35.6 | 83.9 | 40.9 | 12.3 | 60.7 | 6.67 | 0.0 | 0 | 83.80 | 1958.7 | 0.17 | 23.4 |
| V-037 | 31.8 | 83.7 | 41.8 | 11.3 | 61.0 | 5.98 | 0.0 | 0 | 50.00 | 1042.7 | NM | NM |
| V-038 | 20.9 | 84.6 | 45.5 | 8.05 | 60.0 | 3.86 | 0.0 | 0 | 44.40 | 607.7 | 0.23 | 18.5 |
| V-040 | 25.0 | 87.0 | 40.5 | 8.58 | 57.2 | 4.41 | 0.0 | 0 | 73.30 | 1202.0 | NM | NM |
| V-041 | 48.9 | 85.9 | 40.5 | 16.8 | 59.2 | 8.93 | 0.0 | 0 | 64.80 | 2080.1 | NM | NM |
| V-043 | 18.0 | 91.6 | 40.7 | 6.21 | 57.1 | 3.17 | 0.0 | 0 | 61.60 | 728.0 | NM | NM |
| V-044 | 38.8 | 82.9 | 41.8 | 13.7 | 60.5 | 7.24 | 0.0 | 0 | 43.20 | 1099.9 | NM | NM |

# Table 4-7
# (Continued)

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-045 | 35.1 | 86.5 | 42.2 | 12.5 | 58.4 | 6.31 | 0.0 | 0 | 47.20 | 1085.6 | NM | NM |
| V-046 | 36.0 | 90.1 | 41.3 | 12.6 | 57.5 | 6.37 | 0.0 | 0 | 84.60 | 1996.2 | NM | NM |
| V-047 | 29.8 | 94.5 | 40.3 | 10.2 | 57.4 | 5.28 | 0.0 | 0 | 104.00 | 2035.0 | NM | NM |
| V-050 | 26.3 | 82.5 | 43.5 | 9.69 | 56.3 | 4.56 | 0.0 | 0 | 49.80 | 858.4 | NM | NM |
| V-051 | 36.0 | 90.2 | 40.4 | 12.3 | 57.7 | 6.40 | 0.0 | 0 | 52.60 | 1242.2 | NM | NM |
| V-052 | 52.2 | 79.5 | 41.3 | 18.3 | 63.2 | 10.2 | 0.1 | 0.03 | 27.80 | 952.6 | 0.59 | 119.1 |
| V-054 | 17.4 | 83.9 | 41.3 | 6.08 | 57.0 | 3.05 | 0.0 | 0 | 66.00 | 752.3 | 0.49 | 32.9 |
| V-055 | 40.2 | 88.1 | 42.2 | 14.4 | 62.2 | 7.71 | 0.0 | 0 | 64.40 | 1700.0 | NM | NM |
| V-056 | 62.8 | 83.6 | 41.5 | 22.1 | 65.3 | 12.6 | 0.0 | 0 | 54.70 | 2255.2 | NM | NM |
| V-057 | 22.1 | 87.3 | 44.2 | 8.28 | 63.3 | 4.31 | 0.0 | 0 | 65.60 | 951.7 | NM | NM |
| V-058 | 8.99 | 86.1 | 45.5 | 3.47 | 61.6 | 1.71 | 0.0 | 0 | 92.70 | 546.8 | 0.27 | 9.4 |
| V-059 | 31.3 | 80.3 | 46.7 | 12.4 | 64.6 | 6.23 | 0.0 | 0 | 18.20 | 373.8 | NM | NM |
| V-060 | 23.1 | 74.5 | 46.1 | 9.02 | 60.2 | 4.28 | 0.0 | 0 | 30.50 | 461.7 | NM | NM |
| V-061 | 36.2 | 82.4 | 40.0 | 12.3 | 59.0 | 6.58 | 0.0 | 0 | 61.90 | 1469.9 | 0.04 | 5.6 |
| V-062 | 53.2 | 80.2 | 41.9 | 18.9 | 60.8 | 9.96 | 0.0 | 0 | 80.80 | 2818.5 | NM | NM |
| V-063 | 71.8 | 79.3 | 40.5 | 24.7 | 59.8 | 13.2 | 0.0 | 0 | 42.00 | 1979.3 | NM | NM |
| V-067 | 70.0 | 88.6 | 42.6 | 25.3 | 56.8 | 12.3 | 0.3 | 0.13 | 70.80 | 3251.6 | NM | NM |
| V-068 | 49.7 | 84.0 | 46.0 | 19.4 | 63.5 | 9.73 | 0.0 | 0 | 27.00 | 880.7 | NM | NM |
| V-069 | 31.3 | 86.5 | 46.8 | 12.4 | 64.5 | 6.22 | 0.0 | 0 | 21.00 | 430.9 | NM | NM |
| V-070 | 31.4 | 89.5 | 48.4 | 12.9 | 68.8 | 6.66 | 0.0 | 0 | 19.30 | 397.5 | 0.27 | 32.8 |
| V-072 | 19.0 | 81.5 | 44.2 | 7.13 | 56.1 | 3.29 | 0.0 | 0 | 21.35 | 266.5 | NM | NM |
| V-073 | 51.9 | 92.5 | 42.3 | 18.6 | 65.1 | 10.4 | 0.0 | 0 | 46.20 | 1572.2 | NM | NM |
| V-074 | 72.5 | 84.5 | 41.9 | 25.8 | 58.7 | 13.1 | 0.0 | 0 | 46.00 | 2188.4 | NM | NM |
| V-076 | 12.8 | 80.6 | 41.0 | 4.45 | 55.5 | 2.19 | 0.2 | 0.02 | 22.30 | 187.2 | NM | NM |
| V-077 | 26.8 | 88.2 | 45.5 | 10.3 | 62.1 | 5.12 | 0.0 | 0 | 45.00 | 790.2 | 0.27 | 27.9 |
| V-078 | 44.2 | 87.5 | 46.2 | 17.3 | 66.5 | 9.06 | 0.0 | 0 | 28.00 | 812.5 | NM | NM |
| V-079 | 31.4 | 89.3 | 47.2 | 12.5 | 66.8 | 6.46 | 0.0 | 0 | 21.00 | 432.1 | NM | NM |
| V-080 | 22.1 | 82.1 | 47.8 | 8.93 | 64.3 | 4.37 | 0.0 | 0 | 17.50 | 253.2 | 0.85 | 72.4 |

# Table 4-7
## (Continued)

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-083 | 28.5 | 84.2 | 44.5 | 10.8 | 55.5 | 4.88 | 0.0 | 0 | 94.80 | 1775.4 | NM | NM |
| V-084 | 53.9 | 82.8 | 41.6 | 19.0 | 59.1 | 9.82 | 0.0 | 0 | 64.80 | 2292.7 | NM | NM |
| V-085 | 49.3 | 81.6 | 41.1 | 17.2 | 60.6 | 9.22 | 0.0 | 0 | 38.00 | 1230.0 | NM | NM |
| V-086 | 43.2 | 78.5 | 40.9 | 15.0 | 60.8 | 8.10 | 0.0 | 0 | 28.70 | 814.1 | NM | NM |
| V-087 | 65.5 | 82.5 | 44.2 | 24.5 | 62.6 | 12.6 | 0.0 | 0 | 72.00 | 3092.2 | 0.00 | 0.0 |
| V-088 | 63.7 | 91.6 | 45.3 | 24.5 | 68.7 | 13.5 | 0.0 | 0 | 17.30 | 723.2 | NM | NM |
| V-089 | 22.4 | 89.2 | 46.9 | 8.91 | 64.6 | 4.46 | 0.0 | 0 | 22.00 | 323.4 | NM | NM |
| V-090 | 16.5 | 85.2 | 42.9 | 6.01 | 45.0 | 2.29 | 7.3 | 0.74 | 13.50 | 146.3 | NM | NM |
| V-092 | 15.9 | 83.2 | 44.0 | 5.92 | 56.5 | 2.76 | 0.0 | 0 | 26.00 | 270.8 | NM | NM |
| V-093 | 25.4 | 83.7 | 43.9 | 9.44 | 56.1 | 4.39 | 0.0 | 0 | 40.80 | 678.9 | NM | NM |
| V-095 | 35.4 | 84.2 | 40.0 | 12.0 | 54.2 | 5.91 | 0.9 | 0.20 | 11.00 | 255.3 | NM | NM |
| V-096 | 38.2 | 86.2 | 40.8 | 13.2 | 59.1 | 6.96 | 0.0 | 0 | 50.15 | 1256.7 | 0.05 | 7.4 |
| V-098 | 35.4 | 80.7 | 43.6 | 13.1 | 58.3 | 6.36 | 0.0 | 0 | 19.70 | 457.7 | NM | NM |
| V-099 | 6.20 | 87.3 | 43.8 | 2.30 | 56.3 | 1.08 | 0.0 | 0 | 35.70 | 145.2 | NM | NM |
| V-100 | 22.5 | 79.4 | 44.5 | 8.49 | 56.8 | 3.94 | 0.0 | 0 | 17.80 | 262.8 | 0.74 | 64.3 |
| V-101 | 38.9 | 77.3 | 42.5 | 14.0 | 57.8 | 6.93 | 0.0 | 0 | 33.50 | 854.9 | NM | NM |
| V-103 | 46.7 | 91.3 | 44.6 | 17.7 | 58.0 | 8.35 | 0.0 | 0 | 46.50 | 1424.6 | 0.22 | 39.7 |
| V-104 | 67.2 | 81.8 | 45.2 | 25.7 | 63.1 | 13.1 | 0.0 | 0 | 41.40 | 1825.5 | NM | NM |
| V-106 | 34.0 | 89.3 | 18.1 | 5.22 | 24.2 | 2.54 | 11.4 | 2.39 | 5.40 | 120.6 | NM | NM |
| V-107 | 38.4 | 86.3 | 45.6 | 14.8 | 60.7 | 7.19 | 0.2 | 0.05 | 19.65 | 495.1 | 0.00 | 0.0 |
| V-109 | 28.9 | 82.2 | 44.5 | 10.9 | 61.2 | 5.45 | 0.0 | 0 | 17.30 | 328.0 | NM | NM |
| V-110 | 63.1 | 86.2 | 45.3 | 24.2 | 61.4 | 11.9 | 0.0 | 0 | 29.70 | 1230.3 | 0.00 | 0.0 |
| V-112 | 17.2 | 80.9 | 44.8 | 6.52 | 61.2 | 3.24 | 0.0 | 0 | 35.00 | 394.1 | NM | NM |
| V-113 | 42.9 | 87.2 | 46.1 | 16.7 | 62.0 | 8.19 | 0.0 | 0 | 39.80 | 1119.1 | NM | NM |

NM = Not Measured

# Table 4-8
## Concentration and Emission Rates of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Section 3/4 Passive Vents

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-005 | 26.2 | 80.3 | 31.5 | 6.98 | 43.0 | 3.47 | 4.8 | 0.77 | 77.20 | 1330 | NM | NM |
| V-007 | 16.1 | NM | 38.9 | 5.31 | 50.2 | 2.49 | 3.1 | 0.31 | 13.00 | 137 | NM | NM |
| V-008 | 58.0 | 86.3 | 27.9 | 13.7 | 36.1 | 6.46 | 6.1 | 2.18 | 5.10 | 194 | NM | NM |
| V-009 | 35.1 | 83.0 | 38.8 | 11.5 | 56.7 | 6.13 | 0.6 | 0.13 | 39.80 | 915 | NM | NM |
| V-012 | 7.92 | 91.3 | 43.4 | 2.91 | 56.3 | 1.37 | 0.3 | 0.02 | 88.00 | 457 | NM | NM |
| V-013 | 49.6 | 80.1 | 40.0 | 16.8 | 60.5 | 9.25 | 1.0 | 0.31 | 35.80 | 1170 | 0.00 | 0.0 |
| V-016 | 40.0 | 84.7 | 24.2 | 8.20 | 35.0 | 4.31 | 7.8 | 1.92 | 9.30 | 244 | 0.00 | 0.0 |
| V-017 | 46.5 | 81.9 | 41.2 | 16.2 | 62.1 | 8.90 | 0.0 | 0.00 | 71.90 | 2190 | 0.10 | 18.0 |
| V-019 | 15.4 | 85.1 | 45.1 | 5.88 | 59.0 | 2.80 | 0.0 | 0.00 | 81.30 | 820 | NM | NM |
| V-020 | 32.4 | 82.9 | 45.2 | 12.4 | 60.2 | 6.02 | 0.0 | 0.00 | 88.00 | 1870 | 0.07 | 8.77 |
| V-021 | 33.7 | 87.1 | 45.2 | 12.9 | 59.8 | 6.21 | 0.0 | 0.00 | 61.80 | 1370 | NM | NM |
| V-022 | 70.5 | 82.7 | 40.2 | 24.0 | 67.0 | 14.6 | 0.0 | 0.00 | 53.70 | 2480 | NM | NM |
| V-027 | 17.7 | 90.2 | 40.6 | 6.10 | 51.3 | 2.80 | 1.7 | 0.19 | 7.70 | 89.6 | NM | NM |
| V-028 | 73.8 | 83.4 | 40.8 | 25.5 | 64.8 | 14.7 | 0.0 | 0.00 | 53.60 | 2600 | NM | NM |
| V-030 | 14.1 | 83.6 | 43.4 | 5.18 | 61.3 | 2.66 | 0.0 | 0.00 | 220.00 | 2030 | NM | NM |
| V-031 | 12.1 | 81.4 | 44.5 | 4.57 | 61.0 | 2.28 | 0.0 | 0.00 | 120.00 | 954 | NM | NM |
| V-032 | 27.0 | 88.3 | 43.5 | 9.94 | 58.1 | 4.83 | 0.3 | 0.05 | 82.60 | 1460 | NM | NM |
| V-033 | 61.6 | 87.2 | 44.0 | 23.0 | 57.3 | 10.9 | 0.1 | 0.04 | 59.00 | 2380 | NM | NM |
| V-034 | 33.7 | 82.4 | 41.2 | 11.8 | 61.3 | 6.37 | 0.0 | 0.00 | 47.30 | 1050 | NM | NM |
| V-035 | 31.6 | 81.7 | 24.8 | 6.65 | 36.8 | 3.59 | 7.7 | 1.50 | 15.80 | 328 | NM | NM |
| V-036 | 20.1 | 81.7 | 44.0 | 7.49 | 60.6 | 3.75 | 0.0 | 0.00 | 93.50 | 1230 | NM | NM |
| V-038 | 38.7 | 75.7 | 42.8 | 14.0 | 61.7 | 7.35 | 0.0 | 0.00 | 61.60 | 1560 | NM | NM |
| V-039 | 9.02 | 78.3 | 34.4 | 2.63 | 51.7 | 1.44 | 3.1 | 0.17 | 30.00 | 178 | 0.16 | 5.58 |
| V-040 | 26.3 | 75.7 | 44.0 | 9.82 | 63.6 | 5.16 | 0.0 | 0.00 | 35.20 | 608 | NM | NM |
| V-044 | 21.7 | 92.0 | 41.2 | 7.58 | 61.0 | 4.08 | 0.1 | 0.01 | 16.80 | 239 | 0.12 | 10.1 |
| V-045 | 42.5 | 87.2 | 42.2 | 15.2 | 68.0 | 8.90 | 0.0 | 0.00 | 25.10 | 699 | NM | NM |
| V-052 | 44.9 | 79.4 | 40.4 | 15.4 | 65.8 | 9.10 | 0.0 | 0.00 | 80.80 | 2380 | NM | NM |

# Table 4-8
# (Continued)

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-053 | 33.4 | 82.7 | 41.0 | 11.6 | 61.0 | 6.29 | 0.4 | 0.08 | 8.30 | 182 | NM | NM |
| V-055 | 80.1 | 71.3 | 44.8 | 30.4 | 60.4 | 14.9 | 0.0 | 0.00 | 19.00 | 998 | 0.28 | 86.7 |
| V-059 | 31.0 | 91.7 | 33.1 | 8.69 | 49.6 | 4.74 | 5.1 | 0.97 | 26.30 | 535 | 0.27 | 32.3 |
| V-060 | 39.6 | 86.8 | 42.4 | 14.2 | 63.6 | 7.76 | 0.2 | 0.05 | 70.00 | 1820 | NM | NM |
| V-068 | 50.6 | 87.1 | 36.1 | 15.5 | 49.4 | 7.70 | 3.4 | 1.06 | 37.00 | 1230 | NM | NM |
| V-070 | 19.9 | 83.7 | 47.4 | 8.00 | 61.4 | 3.77 | 0.0 | 0.00 | 96.80 | 1270 | 0.80 | 61.5 |
| V-073 | 22.8 | 86.4 | 43.7 | 8.46 | 69.1 | 4.87 | 0.0 | 0.00 | 23.50 | 352 | NM | NM |
| V-074 | 75.6 | 84.1 | 41.6 | 26.6 | 68.5 | 16.0 | 0.0 | 0.00 | 51.70 | 2560 | NM | NM |
| V-075 | 32.8 | 80.6 | 42.2 | 11.7 | 63.3 | 6.39 | 0.0 | 0.00 | 71.75 | 1540 | NM | NM |
| V-076 | 86.5 | 87.3 | 43.2 | 31.7 | 62.4 | 16.6 | 0.0 | 0.00 | 84.00 | 4770 | NM | NM |
| V-083 | 33.2 | 89.0 | 38.7 | 10.9 | 51.3 | 5.24 | 2.8 | 0.57 | 28.80 | 627 | NM | NM |
| V-084 | 15.4 | 91.7 | 23.3 | 3.03 | 31.3 | 1.48 | 9.1 | 0.86 | 11.10 | 112 | NM | NM |
| V-087 | 30.0 | 81.5 | 45.4 | 11.5 | 62.1 | 5.74 | 0.1 | 0.02 | 112.00 | 2200 | NM | NM |
| V-088 | 22.5 | 86.5 | 43.0 | 8.20 | 59.6 | 4.13 | 0.9 | 0.13 | 156.00 | 2300 | NM | NM |
| V-089 | 33.2 | 89.1 | 43.2 | 12.1 | 62.6 | 6.40 | 0.2 | 0.04 | 194.00 | 4220 | NM | NM |
| V-091 | 26.2 | 86.1 | 24.6 | 5.47 | 35.4 | 2.86 | 8.8 | 1.42 | 10.10 | 174 | NM | NM |
| V-093N | 12.9 | 90.8 | 39.1 | 4.26 | 55.6 | 2.20 | 0.2 | 0.02 | 60.80 | 513 | NM | NM |
| V-095 | 11.7 | 72.0 | 33.1 | 3.29 | 49.1 | 1.77 | 2.6 | 0.19 | 0.02 | 0 | 0.18 | 8.15 |
| V-096E | 57.7 | 89.5 | 36.4 | 17.8 | 57.3 | 10.2 | 0.7 | 0.25 | 32.00 | 1210 | NM | NM |
| V-096W | 25.0 | 91.2 | 33.7 | 7.13 | 48.3 | 3.72 | 3.3 | 0.51 | 2.30 | 37.7 | NM | NM |
| V-097 | 19.5 | 88.2 | 43.1 | 7.12 | 63.1 | 3.79 | 0.0 | 0.00 | 49.60 | 634 | 0.33 | 24.9 |
| V-098 | 36.0 | 88.9 | 43.4 | 13.2 | 64.3 | 7.13 | 0.0 | 0.00 | 164.80 | 3890 | NM | NM |
| V-099 | 32.6 | 84.8 | 43.4 | 12.0 | 64.1 | 6.44 | 0.0 | 0.00 | 71.20 | 1520 | NM | NM |
| V-100 | 2.92 | 76.2 | 36.7 | 0.91 | 54.3 | 0.49 | 0.3 | 0.01 | 29.80 | 57.1 | NM | NM |
| V-103 | 17.7 | 81.7 | 17.1 | 2.56 | 23.8 | 1.30 | 12.3 | 1.34 | 0.11 | 1.30 | NM | NM |
| V-106 | 8.14 | 74.2 | 29.6 | 2.04 | 48.4 | 1.21 | 4.4 | 0.22 | 20.60 | 110 | 0.11 | 3.5 |
| V-108 | 14.9 | 81.3 | 35.8 | 4.51 | 44.2 | 2.03 | 6.7 | 0.61 | 3.40 | 33.2 | 0.38 | 21.8 |
| V-110 | 53.6 | 77.2 | 35.7 | 16.2 | 49.3 | 8.14 | 3.9 | 1.29 | 1.20 | 42.2 | NM | NM |

# Table 4-8
## (Continued)

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-111 | 63.9 | 89.0 | 43.4 | 23.5 | 62.6 | 12.3 | 0.0 | 0.00 | 35.50 | 1490 | NM | NM |
| V-112 | 28.9 | 70.3 | 40.0 | 9.81 | 62.7 | 5.59 | 0.0 | 0.00 | 31.70 | 602 | NM | NM |
| V-113 | 58.1 | 80.0 | 44.1 | 21.7 | 62.6 | 11.2 | 0.0 | 0.00 | 43.60 | 1660 | 0.50 | 112 |
| V-114 | 61.5 | 80.3 | 43.9 | 22.9 | 64.7 | 12.3 | 0.0 | 0.00 | 59.40 | 2400 | NM | NM |
| V-115 | 37.9 | 87.2 | 40.7 | 13.1 | 63.1 | 7.36 | 0.0 | 0.00 | 65.30 | 1620 | NM | NM |
| V-116 | 0.44 | 75.4 | 35.5 | 0.13 | 65.0 | 0.09 | 0.0 | 0.00 | 43.30 | 12.5 | NM | NM |
| V-117 | 18.8 | 83.0 | 45.3 | 7.23 | 62.4 | 3.62 | 0.3 | 0.04 | 66.10 | 816 | NM | NM |
| V-118 | 51.6 | 79.5 | 43.0 | 18.8 | 62.8 | 9.99 | 0.0 | 0.00 | 75.00 | 2540 | NM | NM |
| V-119 | 34.4 | 85.1 | 43.7 | 12.7 | 63.0 | 6.67 | 0.0 | 0.00 | 82.40 | 1860 | 0.22 | 29.2 |
| V-120 | 32.9 | 70.2 | 34.2 | 9.55 | 65.6 | 6.66 | 0.0 | 0.00 | 22.00 | 476 | NM | NM |
| V-121 | 7.35 | 80.2 | 36.7 | 2.29 | 65.9 | 1.49 | 0.0 | 0.00 | 53.80 | 259 | 1.85 | 52.6 |
| V-122 | 11.5 | 79.7 | 38.4 | 3.75 | 66.0 | 2.34 | 0.0 | 0.00 | 74.35 | 562 | 1.02 | 45.4 |
| V-123 | 16.6 | 83.1 | 40.2 | 5.65 | 64.9 | 3.32 | 0.0 | 0.00 | 68.00 | 740 | NM | NM |
| V-126 | 6.72 | 83.9 | 24.1 | 1.37 | 39.9 | 0.83 | 7.8 | 0.32 | 17.80 | 78.5 | NM | NM |
| V-127 | 9.93 | 81.9 | 28.9 | 2.43 | 45.4 | 1.39 | 5.0 | 0.31 | 10.40 | 67.8 | NM | NM |
| V-128 | 27.4 | 85.7 | 40.8 | 9.47 | 57.7 | 4.87 | 0.9 | 0.15 | 20.80 | 374 | NM | NM |
| V-131 | 6.52 | 78.4 | 21.6 | 1.19 | 32.4 | 0.65 | 8.2 | 0.33 | 0.30 | 1.28 | NM | NM |
| V-132 | 39.6 | 87.9 | 32.3 | 10.8 | 42.3 | 5.17 | 3.3 | 0.81 | 2.50 | 65.0 | 0.37 | 56.7 |
| V-133 | 36.6 | 85.1 | 35.5 | 11.0 | 52.2 | 5.90 | 1.4 | 0.32 | 5.80 | 139 | 0.48 | 68.0 |
| V-134 | 4.85 | 74.2 | 32.2 | 1.32 | 44.2 | 0.66 | 0.6 | 0.02 | 0.58 | 1.9 | NM | NM |
| V-136 | 14.5 | 84.7 | 8.3 | 1.02 | 10.2 | 0.46 | 14.5 | 1.29 | 0.13 | 1.2 | NM | NM |
| V-137 | 11.3 | 80.5 | 15.1 | 1.45 | 20.2 | 0.70 | 12.5 | 0.87 | 0.24 | 1.8 | NM | NM |
| V-139 | 10.5 | 82.0 | 11.6 | 1.04 | 12.8 | 0.42 | 10.7 | 0.70 | 0.14 | 1.0 | 0.00 | 0.0 |

NM = Not Measured

# Table 4-9
# Concentration and Emission Rates of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Section 1/9 Passive Vents

| Passive Vent # | Flow Rate (acfm) | Temp (Deg F) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| V-901 | 15.0 | 81.2 | 37.0 | 4.70 | 51.6 | 2.38 | 2.0 | 0.19 | 31.70 | 312 | NM | NM |
| V-902 | 18.9 | 81.8 | 34.7 | 5.57 | 48.2 | 2.81 | 3.4 | 0.40 | 30.50 | 379 | 0.12 | 8.78 |
| V-905 | 38.2 | 82.0 | 39.5 | 12.8 | 56.0 | 6.60 | 0.9 | 0.21 | 35.00 | 878 | NM | NM |
| V-906 | 10.8 | 80.3 | 35.6 | 3.26 | 50.0 | 1.66 | 2.5 | 0.17 | 26.30 | 186 | NM | NM |
| V-913 | 23.7 | 82.3 | 37.4 | 7.51 | 55.7 | 4.07 | 0.8 | 0.12 | 21.70 | 337 | NM | NM |
| V-914 | 11.2 | 84.2 | 39.0 | 3.69 | 57.3 | 1.97 | 0.3 | 0.02 | 18.00 | 132 | NM | NM |
| V-916 | 12.2 | 80.2 | 40.7 | 4.19 | 60.8 | 2.28 | 0.0 | 0.00 | 26.00 | 207 | 1.03 | 48.4 |
| V-918 | 19.7 | 79.4 | 21.3 | 3.56 | 31.7 | 1.93 | 9.0 | 1.09 | 10.80 | 140 | NM | NM |
| V-919 | 15.8 | 77.9 | 21.5 | 2.88 | 32.0 | 1.56 | 8.8 | 0.86 | 8.60 | 89.2 | NM | NM |
| V-923 | 16.3 | 80.9 | 23.2 | 3.20 | 34.6 | 1.73 | 8.2 | 0.82 | 17.30 | 184 | NM | NM |
| V-924 | 17.1 | 83.3 | 22.1 | 3.20 | 32.0 | 1.68 | 9.5 | 1.00 | 20.00 | 224 | NM | NM |
| V-927 | 7.9 | 85.0 | 21.4 | 1.44 | 26.5 | 0.65 | 9.0 | 0.44 | 7.30 | 37.9 | NM | NM |
| V-928 | 16.2 | 84.8 | 16.8 | 2.31 | 22.0 | 1.10 | 12.4 | 1.24 | 10.80 | 115 | NM | NM |
| V-932 | 24.6 | 89.3 | 16.8 | 3.51 | 20.7 | 1.57 | 12.3 | 1.87 | 5.30 | 85.6 | NM | NM |
| V-934 | 2.94 | 89.5 | 39.1 | 0.97 | 52.5 | 0.48 | 1.1 | 0.02 | 25.00 | 48.2 | 0.53 | 6.02 |

NM = Not Measured

# Table 4-10
## Concentration and Emission Results for Select VOCs from Temporal Sampling of Passive Vents in Section 2/8

| Date | Flow Rate (acfm) | Vinyl Chloride | | 1,1-Dichloroethylene | | Methylene Chloride | | 1,1-Dichloroethane | | c-1,2-Dichloroethylene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) |
| **V-011** | | | | | | | | | | | |
| 07/03/95 | 23.4 | 0.89 | 25.1 | ND | NC | 0.81 | 31.1 | 0.66 | 29.7 | 0.15 | 6.76 |
| 07/10/95 | 22.5 | 0.42 | 11.5 | ND | NC | 0.30 | 11.2 | 0.34 | 14.5 | 0.05 | 2.23 |
| 07/12/95 | 7.20 | ND | NC | ND | NC | 0.67 | 7.85 | 0.49 | 6.75 | 0.09 | 1.20 |
| **V-038** | | | | | | | | | | | |
| 07/05/95 | 20.9 | 2.42 | 60.8 | 0.02 | 0.85 | 0.41 | 14.1 | 0.58 | 23.0 | 1.19 | 46.4 |
| 07/10/95 | 51.3 | 2.88 | 178 | 0.04 | 3.73 | 0.36 | 30.5 | 0.80 | 78.4 | 2.34 | 224 |
| 07/12/95 | 34.8 | 0.45 | 18.8 | ND | NC | 0.45 | 25.7 | 0.56 | 37.5 | 1.08 | 70.2 |
| **V-058** | | | | | | | | | | | |
| 07/05/95 | 8.99 | 5.01 | 54.3 | 0.05 | 0.81 | 0.12 | 1.74 | 0.19 | 3.21 | 8.94 | 150 |
| 07/10/95 | 16.2 | 6.23 | 122 | 0.11 | 3.44 | 0.11 | 2.96 | 0.21 | 6.60 | 9.18 | 278 |
| 07/12/95 | 5.76 | 5.68 | 39.4 | 0.06 | 0.63 | 0.12 | 1.10 | 0.22 | 2.40 | 6.66 | 71.6 |
| **V-107** | | | | | | | | | | | |
| 07/06/95 | 38.4 | 2.66 | 123 | 0.03 | 2.42 | 0.80 | 50.1 | 0.78 | 56.9 | 3.80 | 272 |
| 07/10/95 | 38.1 | 3.60 | 165 | 0.06 | 4.22 | 1.22 | 75.7 | 0.98 | 70.9 | 4.21 | 300 |
| 07/12/95 | 46.1 | 4.49 | 249 | 0.06 | 4.74 | 0.72 | 54.4 | 0.74 | 64.7 | 3.69 | 317 |

# Table 4-10
# (Continued)

| Date | Flow Rate (acfm) | 1,1,1-Trichloroethane | | Benzene | | Toluene | | Chlorobenzene | | Ethylbenzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) |
| **V-011** | | | | | | | | | | | |
| 07/03/95 | 23.4 | 0.07 | 4.43 | 0.07 | 2.41 | 2.02 | 84.1 | 0.24 | 12.3 | 0.10 | 5.03 |
| 07/10/95 | 22.5 | 0.04 | 2.38 | ND | NC | 0.82 | 32.6 | 0.14 | 6.95 | 0.09 | 4.25 |
| 07/12/95 | 7.20 | 0.05 | 0.90 | ND | NC | 1.22 | 15.6 | 0.13 | 1.96 | 0.07 | 1.03 |
| **V-038** | | | | | | | | | | | |
| 07/05/95 | 20.9 | 0.07 | 4.01 | 0.45 | 14.2 | 22.30 | 825 | 2.36 | 107 | 6.73 | 287 |
| 07/10/95 | 51.3 | 0.09 | 12.0 | 0.56 | 43.1 | 28.81 | 2620 | 2.93 | 325 | 7.87 | 825 |
| 07/12/95 | 34.8 | 0.07 | 6.52 | 0.50 | 26.1 | 25.47 | 1570 | 2.53 | 191 | 8.03 | 572 |
| **V-058** | | | | | | | | | | | |
| 07/05/95 | 8.99 | ND | NC | 0.50 | 6.74 | 43.59 | 695 | 2.38 | 46.5 | 16.43 | 302 |
| 07/10/95 | 16.2 | ND | NC | 0.55 | 13.3 | 44.15 | 1270 | 2.48 | 87.2 | 17.50 | 580 |
| 07/12/95 | 5.76 | ND | NC | 0.28 | 2.46 | 22.10 | 226 | 1.23 | 15.4 | 8.92 | 105 |
| **V-107** | | | | | | | | | | | |
| 07/06/95 | 38.4 | 0.23 | 23.2 | 0.66 | 38.0 | 44.86 | 3060 | 2.96 | 247 | 11.73 | 922 |
| 07/10/95 | 38.1 | 0.30 | 29.6 | 0.80 | 45.6 | 52.76 | 3570 | 3.44 | 284 | 12.94 | 1010 |
| 07/12/95 | 46.1 | 0.20 | 23.3 | 0.74 | 51.4 | 52.44 | 4280 | 3.48 | 348 | 13.06 | 1230 |

# Table 4-10
# (Continued)

| Date | Flow Rate (acfm) | p-Xylene+m-Xylene | | Styrene | | o-Xylene | | n-Nonane | | n-Undecane | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) |
| **V-011** | | | | | | | | | | | |
| 07/03/95 | 23.4 | 0.39 | 18.8 | 0.20 | 9.54 | 0.19 | 9.34 | 0.17 | 9.67 | 0.05 | 3.45 |
| 07/10/95 | 22.5 | 0.21 | 9.89 | 0.09 | 4.29 | 0.11 | 5.30 | 0.09 | 5.02 | 0.04 | 2.87 |
| 07/12/95 | 7.20 | 0.27 | 3.99 | 0.14 | 1.98 | 0.13 | 1.98 | 0.11 | 2.03 | 0.09 | 2.03 |
| **V-038** | | | | | | | | | | | |
| 07/05/95 | 20.9 | 8.00 | 341 | 2.66 | 111 | 2.97 | 127 | 5.93 | 306 | 2.65 | 166 |
| 07/10/95 | 51.3 | 9.92 | 1040 | 3.75 | 386 | 3.24 | 340 | 7.14 | 905 | 2.92 | 451 |
| 07/12/95 | 34.8 | 9.83 | 700 | 3.22 | 225 | 3.67 | 261 | 6.75 | 580 | 3.40 | 356 |
| **V-058** | | | | | | | | | | | |
| 07/05/95 | 8.99 | 28.98 | 533 | 4.20 | 75.7 | 9.12 | 168 | 9.62 | 214 | 4.43 | 120 |
| 07/10/95 | 16.2 | 30.29 | 1000 | 4.41 | 143 | 9.72 | 322 | 9.89 | 396 | 5.68 | 277 |
| 07/12/95 | 5.76 | 15.43 | 182 | 2.28 | 26.4 | 4.76 | 56.0 | 5.02 | 71.5 | 2.43 | 42.1 |
| **V-107** | | | | | | | | | | | |
| 07/06/95 | 38.4 | 22.83 | 1790 | 5.19 | 400 | 8.71 | 685 | 9.16 | 896 | 2.88 | 333 |
| 07/10/95 | 38.1 | 24.98 | 1950 | 5.80 | 443 | 9.25 | 721 | 10.49 | 987 | 3.25 | 373 |
| 07/12/95 | 46.1 | 26.31 | 2480 | 5.99 | 554 | 10.79 | 1020 | 10.44 | 1190 | 3.14 | 435 |

# Table 4-10
# (Continued)

| Date | Flow Rate (acfm) | Benzyl Chloride & m-Dichlorobenzene (ppm) | Benzyl Chloride & m-Dichlorobenzene (µg/sec) | n-Decane & p-Dichlorobenzene (ppm) | n-Decane & p-Dichlorobenzene (µg/sec) | Trichloroethene (ppm) | Trichloroethene (µg/sec) | 1,2,4 Trimethylbenzene & t-Butylbenzene (ppm) | 1,2,4 Trimethylbenzene & t-Butylbenzene (µg/sec) | TNMHC (ppm) | TNMHC (µg/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **V-011** | | | | | | | | | | | |
| 07/03/95 | 23.4 | ND | NC | 0.32 | 21.1 | 0.19 | 11.5 | 0.11 | 6.40 | 87.64 | 3400 |
| 07/10/95 | 22.5 | ND | NC | 0.16 | 10.3 | 0.06 | 3.50 | 0.07 | 4.02 | 54.11 | 2020 |
| 07/12/95 | 7.20 | 0.05 | 0.87 | 0.44 | 8.75 | 0.12 | 2.24 | 0.26 | 4.61 | 65.48 | 781 |
| **V-038** | | | | | | | | | | | |
| 07/05/95 | 20.9 | 1.55 | 85.0 | 12.51 | 727 | 0.28 | 14.9 | 4.37 | 224 | 437.78 | 15100 |
| 07/10/95 | 51.3 | 2.46 | 333 | 14.73 | 2100 | 0.52 | 66.9 | 4.93 | 619 | 489.50 | 41600 |
| 07/12/95 | 34.8 | 1.14 | 104 | 17.71 | 1720 | 0.24 | 21.3 | 5.38 | 459 | 462.10 | 26600 |
| **V-058** | | | | | | | | | | | |
| 07/05/95 | 8.99 | 1.20 | 28.3 | 21.34 | 534 | 1.18 | 26.8 | 8.90 | 196 | 649.10 | 9670 |
| 07/10/95 | 16.2 | 2.54 | 109 | 23.04 | 1040 | 1.01 | 41.4 | 9.26 | 368 | 656.70 | 17600 |
| 07/12/95 | 5.76 | 0.60 | 9.11 | 11.42 | 183 | 0.97 | 14.1 | 4.69 | 66.1 | 682.10 | 6510 |
| **V-107** | | | | | | | | | | | |
| 07/06/95 | 38.4 | 2.35 | 238 | 18.42 | 1970 | 0.93 | 90.9 | 6.22 | 585 | 659.98 | 42000 |
| 07/10/95 | 38.1 | 3.02 | 303 | 20.21 | 2140 | 1.18 | 113 | 7.68 | 717 | 712.80 | 45000 |
| 07/12/95 | 46.1 | 1.39 | 169 | 22.62 | 2900 | 1.22 | 142 | 8.00 | 911 | 738.60 | 56400 |

ND = Not Detected
NC = Not Calculated

# Table 4-11
# Concentration and Emission Results for Select VOCs from Temporal Sampling of Passive Vents in Section 3/4

| Date | Flow Rate (acfm) | Vinyl Chloride | | 1,1-Dichloroethylene | | Methylene Chloride | | 1,1-Dichloroethane | | c-1,2-Dichloroethylene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **V-020** | | | | | | | | | | | |
| 06/30/95 | 32.4 | 1.94 | 75.9 | ND | NC | ND | NC | ND | NC | 0.26 | 15.7 |
| 07/05/95 | 30.4 | 2.04 | 74.7 | ND | NC | ND | NC | ND | NC | 0.33 | 18.8 |
| 07/11/95 | 37.3 | 2.09 | 93.6 | ND | NC | ND | NC | ND | NC | 0.27 | 18.8 |
| **V055** | | | | | | | | | | | |
| 06/29/95 | 80.1 | 6.74 | 650 | ND | NC | ND | NC | 0.06 | 9.74 | 0.48 | 71.1 |
| 07/07/95 | 18.8 | 8.83 | 199 | ND | NC | ND | NC | 0.08 | 2.78 | 0.73 | 25.5 |
| 07/11/95 | 37.1 | 8.00 | 357 | ND | NC | ND | NC | 0.08 | 5.81 | 0.77 | 53.1 |
| **V-097** | | | | | | | | | | | |
| 06/30/95 | 19.5 | 2.04 | 47.9 | ND | NC | ND | NC | 0.34 | 12.7 | 0.34 | 12.4 |
| 07/06/95 | 23.5 | 1.93 | 54.5 | ND | NC | ND | NC | 0.30 | 13.3 | 0.18 | 8.03 |
| 07/11/95 | 26.7 | 2.24 | 72.0 | ND | NC | ND | NC | 0.36 | 18.2 | 0.30 | 15.2 |
| **V-121** | | | | | | | | | | | |
| 06/29/95 | 7.35 | 0.35 | 3.07 | ND | NC | 0.04 | 0.54 | 0.15 | 2.09 | 0.32 | 4.32 |
| 07/06/95 | 13.2 | 1.27 | 20.3 | ND | NC | 0.06 | 1.32 | 0.14 | 3.60 | 0.35 | 8.54 |
| 07/11/95 | 10.9 | 0.67 | 8.71 | ND | NC | 0.05 | 0.85 | 0.14 | 2.81 | 0.32 | 6.49 |

# Table 4-11
## (Continued)

| Date | Flow Rate (acfm) | 1,1,1-Trichloroethane | | Benzene | | Toluene | | Chlorobenzene | | Ethylbenzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **V-020** | | | | | | | | | | | |
| 06/30/95 | 32.4 | ND | NC | 0.81 | 39.5 | 17.14 | 986 | 1.63 | 114 | 13.37 | 887 |
| 07/05/95 | 30.4 | ND | NC | 0.86 | 39.1 | 20.09 | 1080 | 1.68 | 110 | 13.98 | 869 |
| 07/11/95 | 37.3 | ND | NC | 0.85 | 47.7 | 18.48 | 1220 | 1.70 | 138 | 14.09 | 1070 |
| **V055** | | | | | | | | | | | |
| 06/29/95 | 80.1 | ND | NC | 0.47 | 56.2 | 27.44 | 3900 | 2.48 | 432 | 9.98 | 1630 |
| 07/07/95 | 18.8 | ND | NC | 0.63 | 17.7 | 34.36 | 1140 | 2.95 | 120 | 16.38 | 629 |
| 07/11/95 | 37.1 | 0.03 | 2.58 | 0.61 | 34.2 | 30.66 | 2020 | 2.84 | 228 | 16.27 | 1230 |
| **V-097** | | | | | | | | | | | |
| 06/30/95 | 19.5 | 0.03 | 1.08 | 0.84 | 24.7 | 9.90 | 342 | 2.98 | 126 | 11.33 | 452 |
| 07/06/95 | 23.5 | ND | NC | 0.80 | 28.4 | 8.02 | 335 | 2.65 | 135 | 10.16 | 489 |
| 07/11/95 | 26.7 | ND | NC | 0.90 | 36.3 | 9.16 | 434 | 3.00 | 174 | 11.64 | 636 |
| **V-121** | | | | | | | | | | | |
| 06/29/95 | 7.35 | 0.03 | 0.65 | 0.66 | 7.27 | 13.72 | 179 | 2.22 | 35.4 | 9.54 | 144 |
| 07/06/95 | 13.2 | 0.03 | 1.00 | 0.72 | 14.3 | 14.13 | 332 | 2.22 | 63.7 | 9.86 | 267 |
| 07/11/95 | 10.9 | 0.05 | 1.27 | 0.71 | 11.7 | 14.09 | 272 | 2.28 | 53.8 | 10.45 | 233 |

## Table 4-11
## (Continued)

| Date | Flow Rate (acfm) | p-Xylene+m-Xylene | | Styrene | | o-Xylene | | n-Nonane | | n-Undecane | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) | (ppm) | (μg/sec) |
| **V-020** | | | | | | | | | | | |
| 06/30/95 | 32.4 | 18.42 | 1220 | 1.81 | 118 | 6.77 | 449 | 7.62 | 610 | 3.89 | 380 |
| 07/05/95 | 30.4 | 19.03 | 1180 | 1.92 | 117 | 7.05 | 438 | 7.87 | 591 | 4.30 | 394 |
| 07/11/95 | 37.3 | 19.93 | 1520 | 1.68 | 125 | 7.13 | 544 | 8.20 | 755 | 5.08 | 570 |
| **V055** | | | | | | | | | | | |
| 06/29/95 | 80.1 | 18.28 | 3000 | 2.46 | 394 | 6.54 | 1070 | 10.55 | 2090 | 1.61 | 388 |
| 07/07/95 | 18.8 | 23.96 | 920 | 3.01 | 113 | 8.24 | 316 | 12.52 | 581 | 1.86 | 105 |
| 07/11/95 | 37.1 | 23.29 | 1770 | 2.58 | 192 | 7.92 | 600 | 12.20 | 1120 | 2.38 | 265 |
| **V-097** | | | | | | | | | | | |
| 06/30/95 | 19.5 | 12.89 | 514 | 3.12 | 122 | 5.12 | 204 | 9.65 | 465 | 4.90 | 287 |
| 07/06/95 | 23.5 | 11.71 | 564 | 2.86 | 135 | 4.69 | 226 | 8.44 | 491 | 5.63 | 399 |
| 07/11/95 | 26.7 | 13.69 | 748 | 3.17 | 170 | 5.30 | 290 | 9.83 | 649 | 16.73 | 541 |
| **V-121** | | | | | | | | | | | |
| 06/29/95 | 7.35 | 11.41 | 172 | 2.34 | 34.4 | 4.57 | 68.7 | 7.18 | 130 | 4.37 | 96.8 |
| 07/06/95 | 13.2 | 11.57 | 313 | 2.35 | 62.5 | 4.67 | 126 | 7.55 | 247 | 5.27 | 210 |
| 07/11/95 | 10.9 | 12.38 | 276 | 2.58 | 56.2 | 5.01 | 112 | 7.87 | 212 | 5.04 | 165 |

# Table 4-11
## (Continued)

| Date | Flow Rate (acfm) | Benzyl Chloride & m-Dichlorobenzene | | n-Decane & p-Dichlorobenzene | | Trichloroethene | | 1,2,4-Trimethylbenzene & t-Butylbenzene | | TNMHC | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **V-020** | | | | | | | | | | | |
| 06/30/95 | 32.4 | 2.82 | 241 | 21.53 | 1940 | 0.03 | 2.08 | 9.29 | 738 | 486.83 | 26200 |
| 07/05/95 | 30.4 | 2.60 | 208 | 21.52 | 1820 | 0.03 | 1.98 | 8.74 | 650 | 517.90 | 26100 |
| 07/11/95 | 37.3 | 1.90 | 187 | 23.58 | 2450 | 0.03 | 2.74 | 10.48 | 957 | 536.30 | 33100 |
| **V055** | | | | | | | | | | | |
| 06/29/95 | 80.1 | 0.73 | 155 | 14.54 | 3240 | ND | NC | 4.98 | 977 | 440.60 | 58500 |
| 07/07/95 | 18.8 | 2.75 | 136 | 9.65 | 504 | 0.06 | 2.63 | 6.31 | 290 | 526.50 | 16400 |
| 07/11/95 | 37.1 | 1.43 | 140 | 21.15 | 2180 | 0.05 | 4.24 | 8.06 | 732 | 576.30 | 35400 |
| **V-097** | | | | | | | | | | | |
| 06/30/95 | 19.5 | 3.86 | 198 | 23.69 | 1290 | 0.07 | 3.42 | 7.86 | 376 | 540.08 | 17400 |
| 07/06/95 | 23.5 | 3.29 | 204 | 21.65 | 1420 | 0.02 | 1.41 | 7.02 | 405 | 472.20 | 18400 |
| 07/11/95 | 26.7 | 1.97 | 139 | 28.13 | 2090 | 0.05 | 3.08 | 8.36 | 547 | 543.00 | 24000 |
| **V-121** | | | | | | | | | | | |
| 06/29/95 | 7.35 | 1.27 | 24.6 | 20.29 | 415 | 0.09 | 1.68 | 7.16 | 129 | 478.40 | 5830 |
| 07/06/95 | 13.2 | 3.55 | 124 | 21.19 | 782 | 0.09 | 3.01 | 7.81 | 253 | 555.53 | 12200 |
| 07/11/95 | 10.9 | 2.15 | 61.8 | 26.08 | 791 | 0.08 | 2.29 | 8.96 | 239 | 555.60 | 10000 |

ND = Not Detected
NC = Not Calculated

# Table 4-12
## Concentration and Emission Rates of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Temporal Sampling of Section 2/8 Passive Vents

| Date | Flow Rate (acfm) | $CO_2$ (%) | $CO_2$ (g/sec) | $CH_4$ (%) | $CH_4$ (g/sec) | $O_2$ (%) | $O_2$ (g/sec) | $H_2S$ (ppm) | $H_2S$ (ug/sec) | Hg (ppm) | Hg (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **V-011** | | | | | | | | | | | |
| 07/03/95 | 23.4 | 8.0 | 1.59 | 9.3 | 0.67 | 15.9 | 2.30 | 0.29 | 4.46 | 0.23 | 20.8 |
| 07/10/95 | 22.5 | 5.0 | 0.96 | 5.0 | 0.35 | 17.1 | 2.38 | 0.04 | 0.64 | 0.05 | 4.36 |
| 07/10/95-D | 55.7 | 6.1 | 2.88 | 7.0 | 1.20 | 15.6 | 5.36 | NM | NM | NM | NM |
| 07/12/95 | 7.20 | 6.8 | 0.42 | 7.1 | 0.16 | 16.2 | 0.72 | 0.20 | 0.94 | 0.21 | 5.84 |
| **V-038** | | | | | | | | | | | |
| 07/05/95 | 20.9 | 45.5 | 8.05 | 60.0 | 3.86 | 0.0 | 0.0 | 44.40 | 608 | 0.23 | 18.5 |
| 07/10/95 | 51.3 | 43.0 | 18.7 | 62.7 | 9.91 | 0.0 | 0.0 | 46.00 | 1550 | 0.09 | 17.8 |
| 07/10/95-D | 52.7 | 42.1 | 18.8 | 60.8 | 9.88 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/12/95 | 34.8 | 42.4 | 12.5 | 63.1 | 6.77 | 0.0 | 0.0 | 52.25 | 1190 | 0.07 | 9.41 |
| **V-052** | | | | | | | | | | | |
| 07/05/95 | 52.2 | 41.3 | 18.3 | 63.2 | 10.2 | 0.1 | 0.03 | 27.80 | 953 | 0.59 | 119 |
| 07/10/95 | 66.4 | 42.3 | 23.8 | 64.7 | 13.3 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/10/95-D | 27.9 | 41.1 | 9.70 | 61.3 | 5.26 | 0.5 | 0.09 | NM | NM | NM | NM |
| 07/12/95 | 53.3 | 42.2 | 19.1 | 66.3 | 10.9 | 0.0 | 0.0 | NM | NM | NM | NM |
| **V-058** | | | | | | | | | | | |
| 07/05/95 | 8.99 | 45.5 | 3.47 | 61.6 | 1.71 | 0.0 | 0.0 | 92.70 | 547 | 0.27 | 9.38 |
| 07/10/95 | 7.16 | 43.7 | 2.65 | 60.8 | 1.34 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/10/95-D | 16.2 | 43.2 | 5.93 | 62.4 | 3.12 | 0.0 | 0.0 | 81.40 | 865 | NM | NM |
| 07/12/95 | 5.76 | 42.7 | 2.09 | 60.6 | 1.08 | 0.0 | 0.0 | 54.00 | 204 | NM | NM |
| **V-107** | | | | | | | | | | | |
| 07/06/95 | 38.4 | 45.6 | 14.8 | 60.7 | 7.19 | 0.2 | 0.05 | 19.65 | 495 | 0.0 | 0.0 |
| 07/10/95 | 38.1 | 44.6 | 14.4 | 62.1 | 7.29 | 0.0 | 0.0 | 20.00 | 500 | 0.0 | 0.0 |
| 07/10/95-D | 46.5 | 44.0 | 17.3 | 62.5 | 8.96 | 0.0 | 0.0 | NM | NM | NM | NC |
| 07/12/95 | 46.1 | 43.5 | 17.0 | 62.7 | 8.90 | 0.0 | 0.0 | 19.50 | 589 | 0.06 | 10.7 |

# Table 4-13
## Concentration and Emission Results for Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Temporal Sampling of Passive Vents in Section 3/4

| Date | Flow Rate (acfm) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| **V-020** | | | | | | | | | | | |
| 06/30/95 | 32.4 | 45.2 | 12.4 | 60.2 | 6.02 | 0.0 | 0.0 | 88.00 | 1870 | 0.07 | 8.77 |
| 07/06/95 | 30.4 | 44.0 | 11.3 | 57.7 | 5.40 | 0.0 | 0.0 | 96.00 | 1910 | 0.0 | 0.0 |
| 07/11/95 | 19.9 | 43.4 | 7.31 | 61.2 | 3.75 | 0.0 | 0.0 | 75.19 | 980 | 1.72 | 132 |
| 07/11/95-D | 37.3 | 45.5 | 14.4 | 64.7 | 7.43 | 0.0 | 0.0 | NM | NM | NM | NM |
| **V-055** | | | | | | | | | | | |
| 06/29/95 | 80.1 | 44.8 | 30.4 | 60.4 | 14.9 | 0.0 | 0.0 | 19.00 | 998 | 0.28 | 86.7 |
| 07/07/95 | 18.8 | 44.1 | 7.01 | 61.0 | 3.53 | 0.0 | 0.0 | 102.30 | 1260 | 0.52 | 37.7 |
| 07/07/95-D | 17.6 | 44.8 | 6.67 | 61.5 | 3.33 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/11/95 | 19.4 | 44.1 | 7.25 | 60.6 | 3.62 | 0.0 | 0.0 | 64.70 | 824 | 0.20 | 15.0 |
| **V-070** | | | | | | | | | | | |
| 06/29/95 | 19.9 | 47.4 | 8.00 | 61.4 | 3.77 | 0.0 | 0.0 | 96.80 | 1260 | 0.80 | 61.5 |
| 07/06/95 | 20.4 | 43.7 | 7.54 | 61.4 | 3.85 | 0.0 | 0.0 | 92.00 | 1230 | NM | NM |
| 07/06/95-D | 51.1 | 44.2 | 19.1 | 55.8 | 8.78 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/11/95 | 37.5 | 42.4 | 13.5 | 60.8 | 7.03 | 0.0 | 0.0 | NM | NM | NM | NM |

# Table 4-13
## (Continued)

| Date | Flow Rate (acfm) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| **V-097** | | | | | | | | | | | |
| 06/30/95 | 19.5 | 43.1 | 7.12 | 63.1 | 3.79 | 0.0 | 0.0 | 49.60 | 634 | 0.33 | 24.9 |
| 07/06/95 | 23.5 | 42.1 | 8.40 | 64.2 | 4.66 | 0.0 | 0.0 | 37.70 | 582 | NM | NM |
| 07/06/95-D | 28.5 | 39.0 | 9.42 | 60.5 | 5.31 | 0.0 | 0.0 | NM | NM | NM | NM |
| 07/11/95 | 23.3 | 41.8 | 8.25 | 63.9 | 4.58 | 0.0 | 0.0 | 35.77 | 546 | NM | NM |
| **V-121** | | | | | | | | | | | |
| 06/29/95 | 7.35 | 36.7 | 2.29 | 65.9 | 1.49 | 0.0 | 0.0 | 53.80 | 259 | 1.85 | 52.6 |
| 07/06/95 | 13.2 | 41.3 | 4.64 | 64.0 | 2.61 | 0.0 | 0.0 | 45.80 | 398 | 1.42 | 72.7 |
| 07/06/95-D | 12.7 | 39.4 | 4.23 | 58.9 | 2.30 | 0.0 | 0.0 | NM | NM | NA | NM |
| 07/11/95 | 14.0 | 41.3 | 4.89 | 64.4 | 2.77 | 0.0 | 0.0 | 48.20 | 442 | 1.41 | 76.1 |

NM = Not Measured

# Table 4-14
## Summary of Emission Flux Data from Flux Chamber Sampling

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Interval: Lower (ug/m²-min) | 95% Confidence Interval: Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| TNMHC | 0.08 | 100 | 74 | 0.85 | 2.94e+06 | 7.84e+01 | 4.67e+04 | 3.43e+05 | 0.00e+00 | 1.26e+05 |
| Total Unidentified VOCs | 0.08 | 100 | 74 | 0.11 | 1.17e+06 | 1.51e+01 | 1.87e+04 | 1.36e+05 | 0.00e+00 | 5.01e+04 |
| Ethane | 0.08 | 98.7 | 74 | NC | 3.50e+05 | 7.50e-01 | 6.36e+03 | 4.12e+04 | 0.00e+00 | 1.59e+04 |
| Propane | 0.08 | 98.7 | 74 | NC | 2.65e+04 | 9.10e-01 | 5.61e+02 | 3.15e+03 | 0.00e+00 | 1.29e+03 |
| Toluene | 0.08 | 97.3 | 74 | NC | 5.37e+04 | 6.90e-01 | 1.21e+03 | 6.49e+03 | 0.00e+00 | 2.71e+03 |
| Isopentane | 0.08 | 91.9 | 74 | NC | 3.86e+03 | 4.77e+00 | 1.10e+02 | 4.70e+02 | 8.40e-01 | 2.19e+02 |
| n-Butane | 0.08 | 91.9 | 74 | NC | 1.27e+04 | 1.02e+00 | 2.60e+02 | 1.50e+03 | 0.00e+00 | 6.08e+02 |
| n-Decane & p-Dichlorobenzene | 0.08 | 91.9 | 74 | NC | 3.13e+05 | 6.00e-01 | 4.71e+03 | 3.64e+04 | 0.00e+00 | 1.31e+04 |
| Tetrachloroethylene | 0.08 | 91.9 | 74 | NC | 1.81e+03 | 1.50e-01 | 5.20e+01 | 2.58e+02 | 0.00e+00 | 1.12e+02 |
| Isobutene + 1-Butene | 0.08 | 89.2 | 74 | NC | 2.65e+03 | 8.60e-01 | 4.56e+01 | 3.09e+02 | 0.00e+00 | 1.17e+02 |
| p-Xylene + m-Xylene | 0.08 | 89.2 | 74 | NC | 7.65e+04 | 2.30e-01 | 1.23e+03 | 8.92e+03 | 0.00e+00 | 3.30e+03 |
| Propylene | 0.08 | 89.2 | 74 | NC | 6.47e+01 | 4.40e-01 | 3.20e+00 | 8.91e+00 | 1.13e+00 | 5.26e+00 |
| Isobutane | 0.08 | 87.8 | 74 | NC | 3.41e+04 | 1.79e+00 | 6.90e+02 | 4.05e+03 | 0.00e+00 | 1.63e+03 |
| n-Pentane | 0.08 | 87.8 | 74 | NC | 9.01e+02 | 1.15e+00 | 3.33e+01 | 1.25e+02 | 4.40e+00 | 6.21e+01 |
| 3-Methylhexane | 0.08 | 85.1 | 74 | NC | 1.63e+03 | 1.00e-01 | 3.48e+01 | 1.93e+02 | 0.00e+00 | 7.95e+01 |
| Ethylene | 0.08 | 85.1 | 74 | NC | 2.30e+01 | 2.40e-01 | 9.80e-01 | 3.12e+00 | 2.50e-01 | 1.70e+00 |
| Limonene | 0.08 | 83.8 | 74 | NC | 6.20e+04 | 8.50e-01 | 1.30e+03 | 7.41e+03 | 0.00e+00 | 3.02e+03 |
| o-Xylene | 0.08 | 81.1 | 74 | NC | 3.35e+04 | 2.40e-01 | 5.30e+02 | 3.90e+03 | 0.00e+00 | 1.43e+03 |
| Acetone | 0.08 | 79.7 | 74 | NC | 1.50e+03 | 5.60e-01 | 5.36e+01 | 2.24e+02 | 1.64e+00 | 1.05e+02 |
| Ethylbenzene | 0.08 | 78.4 | 74 | NC | 7.15e+04 | 1.90e-01 | 1.11e+03 | 8.32e+03 | 0.00e+00 | 3.04e+03 |
| Hexanal | 0.08 | 78.4 | 74 | NC | 2.75e+03 | 1.70e-01 | 5.17e+01 | 3.22e+02 | 0.00e+00 | 1.26e+02 |
| Methylene Chloride | 0.08 | 78.4 | 74 | NC | 1.84e+02 | 4.00e-02 | 1.16e+01 | 3.51e+01 | 3.45e+00 | 1.97e+01 |
| 1,1,1-Trichloroethane | 0.08 | 77.0 | 74 | NC | 5.04e+02 | 5.00e-02 | 1.26e+01 | 6.12e+01 | 0.00e+00 | 2.68e+01 |
| Trichlorofluoromethane | 0.08 | 75.7 | 74 | NC | 3.75e+03 | 1.30e-01 | 7.61e+01 | 4.41e+02 | 0.00e+00 | 1.78e+02 |
| n-Octane | 0.08 | 75.7 | 74 | NC | 6.18e+03 | 1.10e-01 | 1.25e+02 | 7.30e+02 | 0.00e+00 | 2.94e+02 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.08 | 74.3 | 74 | NC | 8.34e+04 | 1.10e-01 | 1.24e+03 | 9.70e+03 | 0.00e+00 | 3.48e+03 |

# Table 4-14
## (Continued)

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Intervals Lower (ug/m²-min) | 95% Confidence Intervals Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| n-Butylbenzene | 0.08 | 71.6 | 74 | NC | 2.17e+04 | 1.70e-01 | 3.29e+02 | 2.53e+03 | 0.00e+00 | 9.15e+02 |
| Benzene | 0.08 | 68.9 | 74 | NC | 3.13e+03 | 7.00e-02 | 5.04e+01 | 3.65e+02 | 0.00e+00 | 1.35e+02 |
| n-Hexane | 0.08 | 68.9 | 74 | NC | 1.98e+03 | 1.20e-01 | 3.43e+01 | 2.30e+02 | 0.00e+00 | 8.77e+01 |
| Styrene | 0.08 | 66.2 | 74 | NC | 1.42e+04 | 1.60e-01 | 2.77e+02 | 1.68e+03 | 0.00e+00 | 6.66e+02 |
| p-Ethyltoluene | 0.08 | 66.2 | 74 | NC | 3.51e+04 | 1.90e-01 | 5.27e+02 | 4.08e+03 | 0.00e+00 | 1.47e+03 |
| n-Nonane | 0.08 | 66.2 | 74 | NC | 7.11e+04 | 7.00e-02 | 1.14e+03 | 8.29e+03 | 0.00e+00 | 3.06e+03 |
| m-Ethyltoluene | 0.08 | 64.9 | 74 | NC | 3.34e+04 | 7.00e-02 | 5.14e+02 | 3.89e+03 | 0.00e+00 | 1.42e+03 |
| Dichlorodifluoromethane | 0.08 | 63.5 | 74 | NC | 1.98e+04 | 1.00e-01 | 3.39e+02 | 2.31e+03 | 0.00e+00 | 8.74e+02 |
| Trichloroethylene | 0.08 | 63.5 | 74 | NC | 2.04e+01 | 1.00e-02 | 6.90e-01 | 2.63e+00 | 8.00e-02 | 1.30e+00 |
| Methylcyclohexane | 0.08 | 59.5 | 74 | NC | 1.59e+03 | 1.00e-01 | 3.86e+01 | 1.94e+02 | 0.00e+00 | 8.35e+01 |
| 1,1-Dichloroethane | 0.08 | 58.1 | 74 | NC | 4.08e+02 | 3.00e-02 | 1.63e+01 | 6.32e+01 | 1.65e+00 | 3.09e+01 |
| 1,3,5-Trimethylbenzene | 0.08 | 58.1 | 74 | NC | 3.81e+04 | 7.00e-02 | 5.99e+02 | 4.44e+03 | 0.00e+00 | 1.63e+03 |
| t-2-Butene | 0.08 | 58.1 | 74 | NC | 3.73e+01 | 4.00e-02 | 2.43e+00 | 7.35e+00 | 7.30e-01 | 4.14e+00 |
| 1,2,3-Trimethylbenzene | 0.08 | 58.1 | 74 | NC | 1.88e+04 | 8.00e-02 | 2.86e+02 | 2.19e+03 | 0.00e+00 | 7.93e+02 |
| Chloroethane | 0.08 | 56.8 | 74 | NC | 1.38e+02 | 5.00e-02 | 4.88e+00 | 1.90e+01 | 4.80e-01 | 9.28e+00 |
| o-Ethyltoluene | 0.08 | 56.8 | 74 | NC | 6.16e+04 | 4.00e-02 | 9.44e+02 | 7.17e+03 | 0.00e+00 | 2.61e+03 |
| Isoheptane + 2,3-Dimethylpentane | 0.08 | 55.4 | 74 | NC | 2.15e+03 | 3.00e-02 | 4.86e+01 | 2.67e+02 | 0.00e+00 | 1.10e+02 |
| c-1,2-Dichloroethylene | 0.08 | 55.4 | 74 | NC | 8.79e+02 | 1.00e-02 | 2.95e+01 | 1.24e+02 | 7.30e-01 | 5.83e+01 |
| Indene | 0.08 | 54.1 | 74 | NC | 6.00e+01 | 3.00e-02 | 3.04e+00 | 1.06e+01 | 5.90e-01 | 5.49e+00 |
| n-Heptane | 0.08 | 54.1 | 74 | NC | 2.29e+03 | 3.00e-02 | 4.86e+01 | 2.72e+02 | 0.00e+00 | 1.12e+02 |
| 2,2,5-Trimethylhexane | 0.08 | 52.7 | 74 | NC | 3.65e+03 | 3.00e-02 | 5.78e+01 | 4.26e+02 | 0.00e+00 | 1.57e+02 |
| n-Propylbenzene | 0.08 | 52.7 | 74 | NC | 3.25e+04 | 4.00e-02 | 5.14e+02 | 3.79e+03 | 0.00e+00 | 1.39e+03 |
| 2,3,4-Trimethylpentane | 0.08 | 51.4 | 74 | NC | 9.78e+02 | 3.00e-02 | 2.33e+01 | 1.22e+02 | 0.00e+00 | 5.15e+01 |
| Cyclopentane | 0.08 | 51.4 | 74 | NC | 4.72e+02 | 2.00e-02 | 1.01e+01 | 5.60e+01 | 0.00e+00 | 2.31e+01 |
| Methylcyclopentane | 0.08 | 51.4 | 74 | NC | 5.87e+02 | 3.00e-02 | 1.43e+01 | 7.22e+01 | 0.00e+00 | 3.10e+01 |
| Chloromethane | 0.08 | 50.0 | 74 | NC | 3.53e+01 | 1.00e-02 | 9.90e-01 | 4.18e+00 | 2.00e-02 | 1.96e+00 |
| 3-Methylheptane | 0.08 | 47.3 | 74 | NC | 1.57e+03 | NC | 2.96e+01 | 1.84e+02 | 0.00e+00 | 7.22e+01 |

# Table 4-14
## (Continued)

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Intervals Lower (ug/m²-min) | Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| Neohexane | 0.08 | 47.3 | 74 | NC | 4.10e+02 | NC | 7.38e+00 | 4.79e+01 | 0.00e+00 | 1.85e+01 |
| 2-Methyl-1-Butene | 0.08 | 46.0 | 74 | NC | 1.71e+03 | NC | 2.97e+01 | 2.00e+02 | 0.00e+00 | 7.60e+01 |
| Freon 113 | 0.08 | 46.0 | 74 | NC | 3.18e+01 | NC | 1.20e+00 | 5.18e+00 | 0.00e+00 | 2.40e+00 |
| 2-Methyl-2-Butene | 0.08 | 43.2 | 74 | NC | 9.31e+02 | NC | 1.69e+01 | 1.09e+02 | 0.00e+00 | 4.21e+01 |
| 2,2,3-Trimethylpentane | 0.08 | 40.5 | 74 | NC | 2.71e+02 | NC | 7.14e+00 | 3.55e+01 | 0.00e+00 | 1.54e+01 |
| c-2-Butene | 0.08 | 40.5 | 74 | NC | 2.75e+01 | NC | 6.10e-01 | 3.39e+00 | 0.00e+00 | 1.40e+00 |
| 2,3-Dimethylbutane | 0.08 | 36.5 | 74 | NC | 4.53e+00 | NC | 2.20e-01 | 5.80e-01 | 8.00e-02 | 3.50e-01 |
| 2,4-Dimethylpentane | 0.08 | 35.1 | 74 | NC | 6.94e+02 | NC | 1.03e+01 | 8.08e+01 | 0.00e+00 | 2.90e+01 |
| 3-Methyl-1-Butene | 0.08 | 35.1 | 74 | NC | 6.80e+02 | NC | 1.01e+01 | 7.90e+01 | 0.00e+00 | 2.85e+01 |
| 2,5-Dimethylhexane | 0.08 | 32.4 | 74 | NC | 4.38e+02 | NC | 1.11e+01 | 5.79e+01 | 0.00e+00 | 2.45e+01 |
| 1,1-Dichloroethylene | 0.08 | 31.1 | 74 | NC | 1.32e+02 | NC | 3.42e+00 | 1.88e+01 | 0.00e+00 | 7.78e+00 |
| 3-Methylpentane | 0.08 | 31.1 | 74 | NC | 7.16e+02 | NC | 1.14e+01 | 8.34e+01 | 0.00e+00 | 3.07e+01 |
| Isoprene | 0.08 | 29.7 | 74 | NC | 7.00e+02 | NC | 1.20e+01 | 8.19e+01 | 0.00e+00 | 3.09e+01 |
| t-2-Pentene | 0.08 | 28.4 | 74 | NC | 1.15e+02 | NC | 3.18e+00 | 1.66e+01 | 0.00e+00 | 7.02e+00 |
| 1-Hexene | 0.08 | 27.0 | 74 | NC | 1.18e+02 | NC | 4.07e+00 | 1.93e+01 | 0.00e+00 | 8.54e+00 |
| Chloroform | 0.08 | 27.0 | 74 | NC | 1.01e+00 | NC | 7.00e-02 | 1.40e-01 | 3.00e-02 | 1.00e-01 |
| Vinyl Chloride | 0.08 | 25.7 | 74 | NC | 3.68e+03 | NC | 6.98e+01 | 4.37e+02 | 0.00e+00 | 1.71e+02 |
| Acetylene | 0.08 | 24.3 | 74 | NC | 8.15e+01 | NC | 2.07e+00 | NC | NC | NC |
| 1-Octene | 0.08 | 23.0 | 74 | NC | 1.85e+03 | NC | 3.35e+01 | NC | NC | NC |
| 1-Pentene | 0.08 | 23.0 | 74 | NC | 3.71e+00 | NC | 1.80e-01 | NC | NC | NC |
| Chlorobenzene | 0.08 | 23.0 | 74 | NC | 1.25e+04 | NC | 2.13e+02 | NC | NC | NC |
| Methanol | 0.08 | 23.0 | 74 | NC | 1.24e+01 | NC | 6.50e-01 | NC | NC | NC |
| 1,2-Dichloroethane | 0.08 | 21.6 | 74 | NC | 9.00e-01 | NC | 6.00e-02 | NC | NC | NC |
| n-Undecane | 0.08 | 20.3 | 74 | NC | 7.48e+04 | NC | 1.10e+03 | NC | NC | NC |
| 2-Methyl-2-Pentene | 0.08 | 18.9 | 74 | NC | 1.48e+00 | NC | 1.00e-01 | NC | NC | NC |
| Cumene | 0.08 | 18.9 | 74 | NC | 9.76e+03 | NC | 1.47e+02 | NC | NC | NC |
| Naphthalene | 0.08 | 17.6 | 74 | NC | 5.47e+03 | NC | 7.79e+01 | NC | NC | NC |
| m-Diethylbenzene | 0.08 | 17.6 | 74 | NC | 2.30e+04 | NC | 3.38e+02 | NC | NC | NC |

# Table 4-14
# (Continued)

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Intervals Lower (ug/m²-min) | 95% Confidence Intervals Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| p-Diethylbenzene | 0.08 | 17.6 | 74 | NC | 5.02e+04 | NC | 7.49e+02 | NC | NC | NC |
| 1,2-Dichloropropane | 0.08 | 16.2 | 74 | NC | 8.76e+00 | NC | 1.80e-01 | NC | NC | NC |
| Ethanol & Acetonitrile | 0.08 | 16.2 | 74 | NC | 5.49e+03 | NC | 1.54e+02 | NC | NC | NC |
| 1,1,2-Trichloroethane | 0.08 | 14.9 | 74 | NC | 1.48e+00 | NC | 6.00e-02 | NC | NC | NC |
| Diethyl Ether &2-Propanol | 0.08 | 14.9 | 74 | NC | 4.39e+02 | NC | 8.30e+00 | NC | NC | NC |
| c-3-Hexene | 0.08 | 14.9 | 74 | NC | 8.00e-01 | NC | 7.00e-02 | NC | NC | NC |
| 1,1,2,2-Tetrachloroethane | 0.08 | 13.5 | 74 | NC | 8.31e+02 | NC | 1.13e+01 | NC | NC | NC |
| Methylisobutylketone | 0.08 | 13.5 | 74 | NC | 4.22e+00 | NC | 1.40e-01 | NC | NC | NC |
| b-Pinene | 0.08 | 13.5 | 74 | NC | 2.65e+04 | NC | 3.87e+02 | NC | NC | NC |
| t-1,2-Dichloroethylene | 0.08 | 12.2 | 74 | NC | 6.80e-01 | NC | 6.00e-02 | NC | NC | NC |
| Benzyl Chloride &m-Dichlorobenzene | 0.08 | 10.8 | 74 | NC | 3.91e+04 | NC | 5.84e+02 | NC | NC | NC |
| t-2-Hexene | 0.08 | 10.8 | 74 | NC | 5.50e-01 | NC | 6.00e-02 | NC | NC | NC |
| t-1,3-Dichloropropene | 0.08 | 10.8 | 74 | NC | 4.45e+00 | NC | 1.20e-01 | NC | NC | NC |
| Carbon Tetrachloride | 0.08 | 10.8 | 74 | NC | 2.23e+00 | NC | 6.00e-02 | NC | NC | NC |
| 1,2,4-Trichlorobenzene | 0.08 | 9.5 | 74 | NC | 5.56e+03 | NC | 8.71e+01 | NC | NC | NC |
| 1,4-Dioxane & 2,2,4-Trimethylpentane | 0.08 | 9.5 | 74 | NC | 2.90e+03 | NC | 4.76e+01 | NC | NC | NC |
| a-Pinene & Benzaldehyde | 0.08 | 9.5 | 74 | NC | 6.27e+04 | NC | 1.10e+03 | NC | NC | NC |
| o-Dichlorobenzene | 0.08 | 9.5 | 74 | NC | 3.34e+04 | NC | 4.99e+02 | NC | NC | NC |
| c-2-Pentene | 0.08 | 9.5 | 74 | NC | 3.79e+00 | NC | 1.10e-01 | NC | NC | NC |
| Isobutylbenzene | 0.08 | 9.5 | 74 | NC | 1.35e+04 | NC | 2.04e+02 | NC | NC | NC |
| 1,2-Dibromoethane | 0.08 | 9.5 | 74 | NC | 1.01e+00 | NC | 6.00e-02 | NC | NC | NC |
| 1,3-Butadiene | 0.08 | 8.1 | 74 | NC | 1.55e+00 | NC | 1.10e-01 | NC | NC | NC |
| MTBE, Isohexane, &c-4-Methyl-2-Pentane | 0.08 | 8.1 | 74 | NC | 6.77e+02 | NC | 1.51e+01 | NC | NC | NC |
| Hexachloro-1,3-Butadiene | 0.08 | 8.1 | 74 | NC | 8.86e+03 | NC | 1.31e+02 | NC | NC | NC |
| Trichloroethene | 0.08 | 6.8 | 74 | NC | 2.95e+02 | NC | 1.09e+01 | NC | NC | NC |

# Table 4-14
# (Continued)

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Intervals Lower (ug/m²-min) | 95% Confidence Intervals Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| c-1,3-Dichloropropene | 0.08 | 5.4 | 74 | NC | 1.54e+00 | NC | 6.00e-02 | NC | NC | NC |
| Bromodichloromethane | 0.08 | 2.7 | 74 | NC | 3.67e+01 | NC | 8.10e-01 | NC | NC | NC |
| Heptanal | 0.08 | 2.7 | 74 | NC | 4.00e-02 | NC | 4.00e-02 | NC | NC | NC |
| 1-Methylcyclohexene | 0.08 | 1.4 | 74 | NC | 4.57e+01 | NC | 6.60e-01 | NC | NC | NC |
| Bromomethane | 0.08 | 1.4 | 74 | NC | 6.10e-01 | NC | 5.00e-02 | NC | NC | NC |
| Dichlorofluoromethane | 0.08 | 1.4 | 74 | NC | 6.90e-01 | NC | 5.00e-02 | NC | NC | NC |
| Dichlorotoluene | 0.08 | 1.4 | 74 | NC | 5.24e+01 | NC | 7.50e-01 | NC | NC | NC |
| Chlorodifluoromethane | 0.08 | 1.4 | 74 | NC | 9.01e+02 | NC | 1.22e+01 | NC | NC | NC |
| 1-Undecene | 0.08 | 1.4 | 74 | NC | 1.27e+02 | NC | 1.76e+00 | NC | NC | NC |
| 1-Butanol & Cyclohexane | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 1-Decene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| t-4-Methyl-2-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| t-3-Heptene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| t-2-Heptene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| p-Isopropyltoluene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| p-Chlorotoluene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| o-Chlorotoluene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| m-Chlorotoluene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Methyl-2-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Octene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Hexene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Vinyl Bromide | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Vinyl Acetate | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Neopentane | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Methylcyclopentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Butyraldehyde | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Bromoform | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Heptene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |

# Table 4-14
# (Continued)

| Compound | Detection Limit (ug/m²-min) | Percent Detected (%) | Number of Observations | Minimum (ug/m²-min) | Maximum (ug/m²-min) | Median (ug/m²-min) | Average (ug/m²-min) | Standard Deviation (ug/m²-min) | 95% Confidence Intervals Lower (ug/m²-min) | Upper (ug/m²-min) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bromochloromethane | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Acrylonitrile | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Acetaldehyde | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 4-Nonene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 4-Methyl-1-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 3,5,5-Trimethylhexene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2-Methylheptane | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2-Methyl-1-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Indan | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Freon 23 | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Freon 114 | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Dibromochloromethane | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Cyclopentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Cyclohexene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| Chloroprene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2-Ethyl-1-Butene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2-Butanone | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2,4-4-Trimethyl-2-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 2,4,4-Trimethyl-1-Pentene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 1-Propanol | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 1-Nonene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |
| 1-Heptene | 0.08 | 0 | 74 | NC | NC | NC | NC | NC | NC | NC |

NC = Not calculated. Concenration in flux chamber exhaust was below the detection limit.

Note: Limitations of the reported data are given in Table 4-2.

# Table 4-15
## Results of Emission Flux Measurements for Select Compounds from Landfill Surface at Section 2/8

| Compound | Emission Flux ($\mu g/m^2$-min) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FC-2/8-1S | FC-2/8-2TP | FC-2/8-3TP | FC-2/8-4T | FC-2/8-5S | FC-2/8-6S | FC-2/8-7TP | FC-2/8-8S | FC-2/8-9T | FC-2/8-10T |
| Hydrogen Sulfide | 0.719 | 0.804 | 0.521 | 0.205 | 0.574 | 0.521 | 0.521 | 0.345 | 0.213 | 2.77 |
| Carbon Dioxide (a) | 0.0767 | 0.0255 | NC | NC | NC | NC | 0.426 | 0.410 | 0.106 | 2.77 |
| Methane (a) (b) | <0.136 | <0.153 | <0.139 | <0.136 | <0.153 | <0.139 | <0.139 | <0.153 | <0.142 | 1.40 |
| Isobutane | NC | 0.078 | 0.036 | NC | NC | 0.249 | 0.285 | 0.353 | 1.23 | 83.22 |
| Vinyl Chloride | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| n-Butane | NC | 0.039 | 1.05 | 0.088 | 0.078 | 0.124 | 0.142 | 0.137 | 0.553 | 48.6 |
| Isopentane | NC | 0.024 | 0.044 | 0.022 | 0.097 | 0.155 | NC | 0.219 | 2.21 | 19.6 |
| 1,1-Dichloroethylene | NC | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| Methylene Chloride | NC | NC | NC | NC | 0.009 | 0.39 | NC | NC | 0.381 | NC |
| 1,1-Dichloroethane | NC | NC | NC | NC | NC | NC | NC | NC | NC | 1.26 |
| c-1,2-Dichloroethylene | NC | NC | 0.012 | NC | 0.02 | 0.009 | NC | NC | 0.068 | NC |
| 1,1,1-Trichloroethane | 0.012 | NC | NC | NC | 0.009 | NC | NC | NC | NC | NC |
| Benzene | 0.047 | 0.027 | 0.119 | NC | 0.079 | 0.024 | NC | NC | 0.073 | 5.83 |
| Toluene | 0.056 | 0.124 | 0.282 | 0.056 | 0.341 | 0.197 | 0.057 | 0.311 | 0.678 | 5.76 |
| Tetrachloroethylene | 0.03 | 0.011 | 0.102 | NC | 4.19 | 0.051 | NC | 0.011 | 0.022 | NC |
| Ethylbenzene | NC | 0.037 | 0.359 | 0.128 | 0.252 | 0.065 | NC | NC | 0.288 | 109 |
| p-Xylene + m-Xylene | 0.033 | 0.072 | 0.359 | 0.097 | 0.324 | 0.034 | NC | NC | 0.231 | 85.0 |
| Styrene | NC | 0.070 | 0.352 | NC | 0.562 | 0.191 | NC | 0.107 | 0.235 | 15.4 |
| o-Xylene | NC | 0.037 | 0.26 | NC | 0.252 | 0.164 | NC | NC | 0.231 | 15.2 |
| n-Nonane | NC | NC | 0.198 | NC | 0.171 | NC | NC | 0.128 | 0.118 | 51.6 |
| n-Decane & p-Dichlorobenzene | 0.045 | 0.051 | 1.20 | 0.087 | 2.29 | 0.531 | NC | NC | 0.214 | 87.6 |
| 1,2,4 Trimethylbenzene & t-Butylbenzene | NC | 0.026 | 1.09 | 0.038 | 2.79 | 0.312 | NC | 0.987 | 0.345 | NC |
| TNMHC | 3.09 | 5.54 | 159 | 3.53 | 176 | 25.4 | 92.2 | 13.9 | 24.7 | 2520 |

NC = Not Calculated

(a) Flux in terms of $g/m^2$-min

(b) Methane emission flux with < indicates that $CH_4$ in flux chamber exhaust was not detected and lower detection limit of 0.282% $CH_4$ was used to calculate emission flux.

Note: Limitations of the reported data are given in Table 4-2.

# Table 4-16
## Results of Emission Flux Measurements for Selected Compounds from Landfill Surface at Section 3/4

| Compound | Emission Flux ($\mu g/m^2$-min) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | FC-3/4-1T | FC-3/4-2S | FC-3/4-3S | FC-3/4-4S | FC-3/4-5TP | FC-3/4-6S | FC-3/4-7T | FC-3/4-8T | FC-3/4-9S | FC 3/4-10TP | SMM-5 |
| Hydrogen Sulfide | 0.595 | 0.104 | 0.105 | 0.834 | 0.101 | 0.0 | 0.959 | 5.24 | 0.095 | 0.119 | 0.054 |
| Carbon Dioxide (a) | 3.54 | 1.13 | 0.0254 | 0.0523 | 1.07 | 2.83 | 0.388 | 0.0328 | 0.568 | 1.11 | 0.0338 |
| Methane (a) (b) | 3.03 | 1.58 | <0.139 | <0.139 | <0.134 | <0.136 | <0.142 | <0.158 | 0.260 | <0.158 | <0.0715 |
| Isobutane | 31.7 | 30.5 | 0.036 | 0.978 | 0.086 | 3.94 | 0.055 | NC | 18.6 | 0.406 | 0.064 |
| Vinyl Chloride | 0.214 | 0.896 | NC | NC | NC | NC | NC | NC | 0.193 | NC | NC |
| n-Butane | 32.4 | 17.5 | NC | 0.142 | 0.034 | 3.07 | 0.182 | 0.954 | 11.9 | 0.609 | NC |
| Isopentane | 17.1 | 2.31 | NC | 4.51 | 0.043 | 8.84 | 0.09 | NC | 1.24 | 0.05 | 0.068 |
| 1,1-Dichloroethylene | 0.074 | 0.126 | NC | NC | NC | 0.088 | NC | NC | 0.027 | NC | NC |
| Methylene Chloride | 0.913 | 0.028 | NC | 0.078 | NC | 0.154 | 0.212 | 0.012 | 0.017 | NC | 0.008 |
| 1,1-Dichloroethane | 0.905 | 0.097 | NC | NC | NC | NC | NC | NC | 0.278 | NC | NC |
| c-1,2-Dichloroethylene | 0.094 | 0.632 | NC | NC | NC | NC | NC | NC | 0.022 | NC | NC |
| 1,1,1-Trichloroethane | 0.711 | 0.009 | NC | 0.123 | 0.008 | 0.844 | NC | 0.009 | NC | NC | 0.008 |
| Benzene | 3.17 | 4.33 | NC | 0.072 | NC | 0.541 | NC | 0.054 | 1.03 | NC | NC |
| Toluene | 8.19 | 125 | 0.057 | 0.762 | 0.082 | 2.05 | 0.087 | 0.097 | 1.76 | 0.128 | 0.131 |
| Tetrachloroethylene | 0.614 | 0.270 | 0.02 | 0.152 | 0.010 | 0.300 | 0.031 | NC | 0.019 | 0.017 | 0.008 |
| Ethylbenzene | 13.7 | 69.2 | 0.034 | 0.099 | NC | 4.61 | 0.066 | 0.074 | 4.03 | NC | NC |
| p-Xylene + m-Xylene | 9.97 | 76.8 | 0.034 | 0.130 | NC | 3.71 | 0.066 | 0.074 | 2.27 | 0.039 | 0.034 |
| Styrene | 33.7 | 6.85 | NC | NC | NC | 1.19 | NC | NC | 6.90 | NC | NC |
| o-Xylene | 14.0 | 33.7 | NC | 0.065 | NC | 1.76 | 0.029 | 0.039 | 4.44 | NC | 0.013 |
| n-Nonane | 7.57 | 35.0 | NC | NC | NC | 1.35 | 0.04 | NC | 1.04 | NC | NC |
| n-Decane & p-Dichlorobenzene | 48.0 | 178 | 0.089 | 0.843 | 0.171 | 4.79 | 0.318 | 0.154 | 3.70 | 0.101 | 0.046 |
| 1,2,4 Trimethylbenzene & t-Butylbenzene | 55.8 | 73.0 | 0.027 | 0.078 | 0.034 | 2.15 | 0.080 | 0.044 | 6.64 | NC | NC |
| TNMHC | 3340 | 2730 | 2.00 | 14.4 | 6.41 | 124 | 6.78 | 18.0 | 379 | 4.94 | 0.848 |

NC = Not Calculated

(a) Flux in terms of $g/m^2$-min

(b) Mathane emission flux with < indicates that $CH_4$ in flux chamber exhaust was not detected and lower detection limit of 0.282% $CH_4$ was used to calculate emission flux.

Note: Limitations of the reported data are given in Table 4-2.

# Table 4-17
## Results of Emission Flux Measurements for Select Compounds from Landfill Surface at Section 1/9

| Compound | Emission Flux ($\mu g/m^2$-min) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FC-1/9-1TP | FC-1/9-2TP | FC-1/9-3TP | FC-1/9-4S | FC-1/9-5TP | FC-1/9-6TP | FC-1/9-7S | FC-1/9-8S | FC-1/9-9S | FC-1/9-10S |
| Hydrogen Sulfide | 0.201 | 0.205 | 0.128 | 1.95 | 0.130 | 0.813 | 1.23 | 7.60 | 2.17 | 0.855 |
| Carbon Dioxide (a) | 0.0265 | .560 | 0.261 | .629 | .212 | 2.87 | .022 | .0271 | 1.86 | .0453 |
| Methane (a) (b) | <0.134 | 0.149 | <0.170 | 0.466 | <0.172 | <0.154 | <0.136 | <0.154 | 1.01 | <0.142 |
| Isobutane | 0.051 | 38.9 | 1.61 | 43.2 | 0.11 | 0.654 | 0.070 | NC | 30.4 | NC |
| Vinyl Chloride | NC | 0.531 | NC | 2.96 | NC | NC | NC | NC | NC | NC |
| n-Butane | 0.069 | 24.7 | 1.07 | 1.96 | 0.11 | 0.317 | 0.035 | 0.045 | 22.0 | NC |
| Isopentane | 0.043 | 30.4 | 5.02 | 59.4 | 0.302 | 0.197 | 0.370 | 0.049 | 1.30 | NC |
| 1,1-Dichloroethylene | NC | 0.029 | NC | 0.298 | 0.026 | 0.023 | NC | NC | NC | 0.021 |
| Methylene Chloride | 0.018 | 0.232 | 0.016 | 33.6 | 0.016 | 0.014 | 0.010 | 0.013 | 0.12 | 0.013 |
| 1,1-Dichloroethane | 0.015 | 2.97 | 0.483 | 30.3 | NC | NC | NC | NC | NC | 0.016 |
| c-1,2-Dichloroethylene | 0.011 | 1.21 | 0.218 | 2.95 | NC | NC | NC | NC | NC | 0.030 |
| 1,1,1-Trichloroethane | NC | 0.405 | 0.020 | 0.287 | 0.015 | 0.041 | 0.008 | 0.051 | NC | 0.084 |
| Benzene | NC | 0.355 | 0.058 | 0.528 | 0.030 | NC | 0.047 | 0.080 | 4.97 | 0.049 |
| Toluene | 0.135 | 9.92 | 1.49 | 19.6 | 0.174 | 0.189 | 0.084 | 0.102 | 2.61 | 0.694 |
| Tetrachloroethylene | 0.098 | 1.01 | 0.249 | 11.1 | 0.044 | 0.023 | 0.020 | 0.028 | 0.047 | 0.104 |
| Ethylbenzene | NC | 1.74 | 0.361 | 2.48 | 0.162 | 0.362 | NC | 0.101 | 51.1 | 0.067 |
| p-Xylene + m-Xylene | 0.063 | 2.64 | 0.121 | 4.76 | 0.204 | 0.145 | 0.033 | 0.110 | 42.8 | 0.133 |
| Styrene | 0.027 | 2.72 | 0.469 | 3.01 | 0.079 | 0.250 | 0.063 | NC | 15.5 | 0.099 |
| o-Xylene | 0.028 | 1.29 | 0.399 | 2.41 | 0.284 | 0.362 | 0.023 | 0.127 | 13.9 | 0.067 |
| n-Nonane | NC | 3.15 | 0.095 | 4.18 | 0.048 | 0.264 | NC | NC | 50.3 | NC |
| n-Decane & p-Dichlorobenzene | 0.044 | 9.17 | 0.652 | 6.48 | 2.15 | 1.48 | 0.132 | 0.236 | 48.9 | 0.138 |
| 1,2,4 Trimethylbenzene & t-Butylbenzene | NC | 1.78 | 0.334 | 0.976 | 0.629 | 1.04 | 0.023 | 0.152 | 54.0 | NC |
| TNMHC | 3.75 | 297 | 42.6 | 392 | 24.0 | 88.9 | 5.11 | 18.1 | 2760 | 8.89 |

NC = Not Calculated
(a) = Flux in terms of $g/m^2$-min
(b) = Mathane emission flux with < indicates that $CH_4$ in flux chamber exhaust was not detected and lower detection limit of 0.282% $CH_4$ was used to calculate emission flux.
*Note: Limitations of the reported data are given in Table 4-2.*

# Table 4-18
## Results of Emission Flux of Select Compounds from Landfill Surface at Section 6/7

| Compound Name | Emission Flux ($\mu g/m^2$-min) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FC-6/7-1TP | FC-6/7-2TP | FC-6/7-3TP | FC-6/7-4TP | FC-6/7-5TP | FC-6/7-6TP | FC-6/7-7TP | FC-6/7-8TP | FC-6/7-9S |
| Carbon Dioxide (a) | 1.80 | 2.61 | 31.9 | 59.4 | 20.4 | 26.7 | 151 | 1530 | 0.515 |
| Methane (a) (b) | <0.210 | 1.17 | 17.0 | 29.6 | 16.7 | 15.3 | 80.1 | 832 | <0.139 |
| Hydrogen Sulfide | 27.9 | 2.30 | 955 | 2330 | 2540 | 657 | 1830 | 7290 | 1.04 |
| Isobutane | 6.19 | 62.1 | 2750 | 7110 | 831 | 1185 | 2480 | 34100 | 0.356 |
| Vinyl Chloride | NC | 2.95 | 50.0 | 103 | 29.4 | 515 | 653 | 3680 | NC |
| n-Butane | 3.93 | 29.4 | 1030 | 2050 | 361 | 445 | 771 | 12700 | 0.124 |
| Isopentane | 23.8 | 46.0 | 385 | 698 | 143 | 770 | 90.0 | 860 | 0.553 |
| 1,1-Dichloroethylene | NC | 0.375 | 19.9 | 132 | 94.0 | NC | NC | NC | NC |
| Methylene Chloride | 97.2 | 9.85 | 85.2 | 181 | 75.3 | 184 | NC | NC | 0.0520 |
| 1,1-Dichloroethane | 17.0 | 11.4 | 255 | 408 | 258 | 84.3 | NC | NC | 0.0270 |
| c-1,2-Dichloroethylene | NC | 9.47 | 414 | 419 | 232 | 120 | 60.3 | 879 | 0.148 |
| 1,1,1-Trichloroethane | 3.96 | 3.71 | 46.6 | 145 | 53.9 | 44.8 | NC | 504 | 0.0250 |
| Benzene | 1.48 | 2.36 | 71.9 | 152 | 33.1 | 42.3 | 236 | 3130 | 0.0720 |
| Toluene | 47.8 | 103 | 5320 | 13000 | 2560 | 3020 | 9520 | 53700 | 0.902 |
| Tetrachloroethylene | 0.768 | 22.0 | 1810 | 716 | 1120 | 112 | NC | NC | 0.355 |
| Ethylbenzene | NC | 23.0 | 827 | 2220 | 499 | 651 | 5480 | 71500 | 0.520 |
| p-Xylene + m-Xylene | 2.41 | 30.3 | 1390 | 3640 | 906 | 1020 | 6880 | 76500 | 0.424 |
| Styrene | NC | 21.1 | 971 | 2430 | 580 | 509 | 1330 | 14200 | 1.12 |
| o-Xylene | NC | 14.9 | 387 | 1700 | 297 | 282 | 2690 | 33500 | 0.879 |
| n-Nonane | 1.55 | 31.7 | 1220 | 2920 | 657 | 971 | 6620 | 71100 | 0.315 |
| n-Decane & p-Dichlorobenzene | 2.21 | 37.0 | 2340 | 6040 | 1510 | 2220 | 21000 | 313000 | 8.50 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | NC | 12.2 | 555 | 1650 | 417 | 389 | 4380 | 83400 | 2.84 |
| TNMHC | 873 | 1800 | 67900 | 15200 | 56200 | 49300 | 264000 | 2940000 | 173 |

# Table 4-18
# (Continued)

| Compound Name | Emission Flux ($\mu g/m^2$-min) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FC-6/7-10S | FC-6/7-11S | FC-6/7-12S | FC-6/7-13S | FC-6/7-14T | FC-6/7-15S | FC-6/7-16T | FC-6/7-17S | FC-6/7-18S |
| Carbon Dioxide (a) | 0.0210 | NC | 0.212 | 3.11 | 0.490 | 0.320 | 16.3 | 0.817 | 0.0152 |
| Methane (a) (b) | <0.139 | 0.0739 | <0.136 | <0.153 | <0.180 | <0.153 | 9.07 | <0.136 | <0.0684 |
| Hydrogen Sulfide | 0.834 | 1.26 | 0.513 | 0.459 | 167 | 0.804 | 6540 | 1.13 | 0.154 |
| Isobutane | 0.0530 | 27.7 | 4.01 | 25.9 | 1.54 | 6.96 | 577 | 12.6 | 0.123 |
| Vinyl Chloride | NC | 32.8 | NC | NC | 0.512 | NC | 87.0 | NC | NC |
| n-Butane | 0.0360 | 15.9 | 2.59 | 19.5 | 2.28 | 0.568 | 251 | 10.1 | 0.0970 |
| Isopentane | 0.155 | 26.6 | 25.2 | NC | 7.23 | 31.2 | 180 | 56.1 | 0.480 |
| 1,1-Dichloroethylene | NC | 0.131 | 0.0580 | 0.850 | NC | NC | NC | NC | NC |
| Methylene Chloride | 0.0210 | 0.373 | 0.717 | 2.15 | NC | 0.601 | NC | 2.28 | 0.0100 |
| 1,1-Dichloroethane | 0.0300 | 1.77 | 0.955 | 4.31 | NC | NC | 65.3 | 3.19 | 0.0450 |
| c-1,2-Dichloroethylene | 0.0210 | 4.56 | 0.146 | 0.784 | NC | 0.0160 | 35.0 | NC | 0.00400 |
| 1,1,1-Trichloroethane | 0.00800 | 0.180 | 0.764 | 7.74 | 0.0810 | 1.39 | 11.6 | 4.06 | 0.201 |
| Benzene | NC | 2.22 | 0.0710 | 1.08 | 0.380 | 0.0790 | 28.5 | NC | 0.0120 |
| Toluene | 0.0850 | 65.7 | 2.28 | 2.80 | 26.9 | 3.63 | 1810 | 0.804 | 0.111 |
| Tetrachloroethylene | 0.203 | 3.20 | 0.350 | 1.57 | 0.151 | 1.85 | 20.3 | 1.15 | 0.0250 |
| Ethylbenzene | 0.0290 | 17.0 | 0.192 | 1.90 | 6.00 | 0.324 | 479 | 0.161 | 0.0320 |
| p-Xylene + m-Xylene | 0.0340 | 12.4 | 0.417 | 1.83 | 3.87 | 0.539 | 636 | 0.225 | 0.0640 |
| Styrene | NC | 8.80 | 0.346 | 0.421 | 0.855 | 0.0370 | 337 | NC | NC |
| o-Xylene | 0.0210 | 6.65 | 0.128 | 0.753 | 1.52 | 0.252 | 228 | 0.128 | NC |
| n-Nonane | 0.0280 | 11.2 | 0.115 | 0.347 | 3.23 | 0.0860 | 612 | NC | 0.0190 |
| n-Decane & p-Dichlorobenzene | 0.266 | 10.9 | 0.830 | 1.37 | 12.7 | 9.17 | 1640 | 0.349 | 0.175 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.0390 | 5.03 | 0.0770 | 0.558 | 4.98 | 0.472 | 392 | 0.115 | 0.0190 |
| TNMHC | 5.25 | 946 | 63.3 | 467 | 232 | 101 | 32800 | 124 | 2.63 |

# Table 4-18
# (Continued)

| Compound Name | Emission Flux ($\mu g/m^2$-min) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FC-6/7-19S | FC-6/7-20S | FC-6/7-21S | FC-6/7-22S | FC-6/7-23S | FC-6/7-24S | FC-6/7-25S | FC-6/7-26S | FC-6/7-27S |
| Carbon Dioxide (a) | 2.55 | 0.156 | NC | 0.299 | 0.257 | 3.04 | 0.920 | 0.365 | 0.0291 |
| Methane (a) (b) | 0.273 | <0.136 | <0.139 | <0.153 | 0.0441 | <0.153 | 0.0680 | 0.0863 | <0.0684 |
| Hydrogen Sulfide | 0.772 | 1.03 | 0.730 | 0.804 | 13.9 | 25.3 | 1.03 | 4.29 | 7.20 |
| Isobutane | 1430 | 12.6 | 2.45 | 14.3 | 2.63 | 13.5 | 15.5 | 7.62 | 0.123 |
| Vinyl Chloride | NC | NC | NC | NC | NC | 0.590 | 0.106 | 0.0690 | NC |
| n-Butane | 1170 | 4.83 | 2.15 | 12.0 | 5.36 | 9.37 | 6.92 | 3.67 | 0.0790 |
| Isopentane | 3860 | 37.0 | 8.89 | 65.0 | 18.2 | 66.0 | 37.6 | 16.1 | 0.174 |
| 1,1-Dichloroethylene | NC | NC | NC | 0.0650 | NC | 0.196 | 0.197 | 0.0310 | 0.00600 |
| Methylene Chloride | 88.0 | 0.307 | 0.104 | 8.90 | 41.2 | 4.12 | 8.15 | 4.97 | 0.0130 |
| 1,1-Dichloroethane | 12.4 | 0.627 | 0.182 | 7.51 | 3.91 | 5.91 | 9.94 | 2.10 | 0.0450 |
| c-1,2-Dichloroethylene | 0.778 | 0.0120 | 0.0150 | 0.229 | 1.10 | 0.196 | 1.05 | 0.0610 | 0.0130 |
| 1,1,1-Trichloroethane | 42.9 | 1.17 | 0.286 | 0.0180 | 1.12 | 0.405 | 1.71 | 0.233 | 0.0180 |
| Benzene | NC | NC | 0.0470 | 0.343 | 2.12 | 0.0790 | 0.158 | 0.0740 | 0.0230 |
| Toluene | 120 | 0.194 | 0.395 | 27.0 | 23.4 | 1.37 | 3.55 | 1.78 | 0.348 |
| Tetrachloroethylene | 1.08 | 0.350 | 0.812 | 5.82 | 0.524 | 2.40 | 2.47 | 1.45 | 0.0750 |
| Ethylbenzene | NC | NC | 0.0990 | 3.40 | 1.78 | 0.358 | 0.325 | 0.186 | 0.0320 |
| p-Xylene + m-Xylene | 4.78 | NC | 0.130 | 5.95 | 2.55 | 0.358 | 0.396 | 0.321 | 0.0640 |
| Styrene | NC | NC | 0.161 | 3.72 | 5.10 | 1.40 | 0.670 | 0.512 | 0.0480 |
| o-Xylene | NC | NC | 0.585 | 3.80 | 2.15 | 0.645 | 0.431 | 0.354 | 0.0320 |
| n-Nonane | NC | 0.0380 | 0.156 | 1.52 | NC | 0.0310 | 0.0860 | 0.0400 | NC |
| n-Decane & p-Dichlorobenzene | NC | 0.220 | 0.577 | 5.90 | 1.10 | 0.441 | 1.13 | 1.54 | 0.0660 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | NC | NC | 0.0390 | 3.43 | NC | 0.300 | NC | 0.101 | NC |
| TNMHC | 7660 | 69.3 | 46.1 | 465 | 2700 | 179 | 132 | 63.6 | 2.97 |

# Table 4-18
## (Continued)

| Compound Name | Emission Flux ($\mu g/m^2$-min) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FC-6/7-28S | FC-6/7-29T | FC-6/7-30T | FC-6/7-31TP | FC-6/7-32TP | FC-6/7-33TP | FC-6/7-34TP | FC-6/7-35TP | FC-6/7-36TP |
| Carbon Dioxide (a) | 0.417 | 0.0424 | 0.0541 | 0.0882 | 0.0721 | 0.0271 | 0.0186 | 0.0201 | 0.0781 |
| Methane (a) (b) | <0.139 | <0.158 | <0.136 | <0.139 | <0.139 | <0.139 | <0.158 | <0.158 | <0.158 |
| Hydrogen Sulfide | 0.313 | 3.81 | 5.24 | 0.730 | 0.834 | 1.25 | 0.595 | 1.67 | 0.476 |
| Isobutane | 19.0 | NC | 0.403 | 3.74 | 0.320 | 0.178 | 0.122 | NC | 4.24 |
| Vinyl Chloride | NC | NC | NC | NC | NC | NC | NC | NC | NC |
| n-Butane | 7.73 | 0.142 | 0.175 | 0.783 | 0.373 | 0.124 | 0.142 | NC | 1.32 |
| Isopentane | 33.9 | 0.177 | 0.283 | 5.08 | 7.12 | 0.199 | 0.706 | 0.328 | 5.93 |
| 1,1-Dichloroethylene | 0.120 | NC | NC | NC | NC | NC | NC | NC | 1.76 |
| Methylene Chloride | 1.60 | 0.0150 | 0.0260 | 0.156 | NC | 0.0230 | 0.0150 | NC | 0.0590 |
| 1,1-Dichloroethane | 8.90 | NC | NC | 0.121 | 0.333 | 0.0180 | NC | 0.311 | 0.0280 |
| c-1,2-Dichloroethylene | 0.510 | NC | 0.0290 | 0.0120 | NC | NC | NC | NC | NC |
| 1,1,1-Trichloroethane | 2.95 | NC | 0.0120 | 0.0160 | 0.123 | 0.0330 | 0.0190 | 0.0930 | 0.0470 |
| Benzene | 0.0660 | 0.110 | 0.0950 | NC | NC | NC | 0.0280 | NC | 0.0540 |
| Toluene | 0.677 | 0.225 | 0.416 | 0.310 | NC | 0.112 | 0.0970 | 0.385 | 1.61 |
| Tetrachloroethylene | 0.976 | 0.012 | 0.0200 | 0.254 | 0.102 | 0.102 | 0.0170 | 0.753 | 0.116 |
| Ethylbenzene | 0.0910 | 0.187 | 0.384 | 0.0340 | NC | 0.0340 | NC | 0.187 | 0.261 |
| p-Xylene + m-Xylene | 0.0830 | 0.223 | 0.384 | 0.0650 | NC | 0.0650 | 0.0390 | NC | 0.371 |
| Styrene | 0.106 | NC | 0.0330 | 0.0330 | NC | NC | NC | NC | 0.256 |
| o-Xylene | 0.0660 | 0.0390 | 0.128 | 0.0650 | 0.260 | 0.0340 | 0.0740 | NC | 0.261 |
| n-Nonane | NC | 0.0440 | 0.0380 | 0.0390 | NC | 0.0780 | 0.0280 | NC | 0.133 |
| n-Decane & p-Dichlorobenzene | 0.303 | 0.154 | 0.262 | 0.223 | NC | 0.443 | 0.101 | 0.404 | 0.606 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.0440 | 0.089 | 0.268 | 0.0390 | NC | 0.0780 | 0.0220 | NC | 0.222 |
| TNMHC | 99.4 | 13.7 | 25.9 | 24.1 | 12.8 | 5.53 | 5.37 | 74.3 | 48.9 |

# Table 4-18
## (Continued)

| Compound Name | Emission Flux ($\mu g/m^2$-min) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FC-6/7-37TP | FC-6/7-38TP | FC-6/7-39TP | FC-6/7-40TP | FC-6/7-41F | FC-6/7-42F | FC-6/7-43F | | |
| Carbon Dioxide (a) | 0.0381 | 0.218 | 0.0653 | 0.0205 | 0.0400 | 0.0260 | 2.12 | | |
| Methane (a) (b) | <0.139 | <0.139 | <0.158 | <0.158 | <0.139 | <0.153 | <0.139 | | |
| Hydrogen Sulfide | 0.313 | 0.834 | 2.02 | 0.595 | 1.04 | 0.459 | 1.36 | | |
| Isobutane | 0.0890 | 21.7 | 1.97 | NC | 0.445 | 2.47 | 31.5 | | |
| Vinyl Chloride | NC | NC | NC | NC | 0.0570 | NC | NC | | |
| n-Butane | 0.0530 | 20.5 | 0.975 | NC | 0.854 | 1.76 | 69.5 | | |
| Isopentane | 0.111 | 248 | 5.30 | 0.908 | 6.79 | 9.45 | 198 | | |
| 1,1-Dichloroethylene | NC | NC | NC | NC | NC | NC | NC | | |
| Methylene Chloride | 0.0260 | 7.77 | 1.48 | 0.0180 | 0.130 | 0.487 | 14.5 | | |
| 1,1-Dichloroethane | NC | 3.33 | 1.66 | NC | 0.0240 | 0.868 | 0.455 | | |
| c-1,2-Dichloroethylene | 0.0120 | NC | 0.102 | NC | NC | NC | NC | | |
| 1,1,1-Trichloroethane | 0.0120 | 24.3 | 1.82 | NC | 0.204 | 8.19 | 15.3 | | |
| Benzene | NC | 0.119 | NC | NC | 0.0240 | NC | NC | | |
| Toluene | 0.0570 | 2.82 | 2.19 | NC | 0.170 | 0.217 | 3.33 | | |
| Tetrachloroethylene | 0.0510 | 0.254 | 1.39 | 0.0230 | 0.406 | 0.112 | 0.305 | | |
| Ethylbenzene | NC | 0.845 | 0.484 | NC | 0.0650 | NC | 0.780 | | |
| p-Xylene + m-Xylene | 0.0340 | 1.95 | 0.816 | NC | 0.130 | NC | 0.944 | | |
| Styrene | NC | 0.607 | 0.256 | NC | 0.161 | NC | 1.21 | | |
| o-Xylene | 0.0260 | 0.325 | 0.261 | NC | 0.0650 | NC | 0.814 | | |
| n-Nonane | 0.0250 | 0.509 | 0.581 | NC | 0.0780 | NC | NC | | |
| n-Decane & p-Dichlorobenzene | 0.0350 | 1.42 | 2.68 | NC | 0.489 | NC | 2.26 | | |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | NC | NC | 0.489 | NC | 0.234 | NC | 3.93 | | |
| TNMHC | 3.12 | 417 | 48.8 | 167 | 82.4 | 26.1 | 741 | | |

NC = Not Calculated

(a) Emission Flux in units of $g/m^2$-min

(b) Methane emission flux with < indicates that $CH_4$ in flux chamber exhaust was not detected and lower detection limit of 0.282% $CH_4$ was used to calculate emission flux.

Note: Limitations of the reported data are given in Table 4-2.

## Table 4-19
## Results of Mercury Flux Measurements at Landfill Surface

| Landfill Section | Sampling Location | Mercury Flux ($\mu$g/min-m$^2$) |
|---|---|---|
| 6/7 | 16T | <0.363[a] |
| 6/7 | 33TP | 0.343 |
| 6/7 | 39TP | 0.391 |
| 6/7 | 3TP | 4.64 |
| 3/4 | SMM-5 | <0.257[a] |
| Field Blank | -- | 0.391 |
| Field Blank | -- | <0.257[a] |
| Field Blank | -- | 0.294 |

[a]Value based on mercury lower detection limit of 0.003 mg/m$^3$ and flux chamber exhaust flow rate.

## Table 4-20
## Emission Flux for Select VOCs from Temporal Sampling of Landfill Surface at Section 6/7

| Date | Isobutane ($\mu g/m^2$-min) | Vinyl Chloride ($\mu g/m^2$-min) | n-Butane ($\mu g/m^2$-min) | 1,1-Dichloroethylene ($\mu g/m^2$-min) | Isopentane ($\mu g/m^2$-min) |
|---|---|---|---|---|---|
| **FC-6/7-16T** | | | | | |
| 07/07/95 | 577 | 87.0 | 251 | NC | 180 |
| 07/10/95 | 609 | 150 | 240 | NC | 202 |
| 07/11/95 | 804 | 106 | 319 | NC | 259 |
| **FC-6/7-28S** | | | | | |
| 07/08/95 | 19.0 | NC | 7.73 | 0.120 | 33.9 |
| 07/10/95 | 20.8 | 0.015 | 9.00 | 0.170 | 45.4 |
| 07/11/95 | 21.5 | 0.057 | 9.66 | NC | 42.4 |
| **FC-6/7-3TP** | | | | | |
| 07/06/95 | 2750 | 50.0 | 1030 | 19.9 | 385 |
| 07/07/95 | 1940 | NC | 848 | NC | 260 |
| 07/10/95 | 3820 | NC | 1630 | NC | 535 |
| 07/11/95 | 10500 | 277 | 5050 | 49.0 | 1590 |
| **FC-6/7-9S** | | | | | |
| 07/05/95 | 0.356 | NC | 0.124 | NC | 0.553 |
| 07/07/95 | 0.638 | NC | 0.323 | 0.087 | 0.814 |
| 07/08/95 | 3.27 | NC | 3.34 | 0.089 | 1.28 |

# Table 4-20
# (Continued)

| Date | Methylene Chloride ($\mu g/m^2$-min) | 1,1-Dichloroethane ($\mu g/m^2$-min) | c-1,2-Dichloroethylene ($\mu g/m^2$-min) | Benzene ($\mu g/m^2$-min) | 1,1,1-Trichloroethane ($\mu g/m^2$-min) |
|---|---|---|---|---|---|
| **FC-6/7-16T** | | | | | |
| 07/07/95 | NC | 65.3 | 35.0 | 28.5 | 11.6 |
| 07/10/95 | NC | 82.3 | 36.1 | 31.5 | 10.2 |
| 07/11/95 | NC | 93.8 | 42.1 | 40.0 | 16.4 |
| **FC-6/7-28S** | | | | | |
| 07/08/95 | 1.60 | 8.90 | 0.510 | 0.066 | 2.95 |
| 07/10/95 | 3.55 | 13.0 | 0.613 | 0.054 | 4.27 |
| 07/11/95 | 4.11 | 5.21 | 0.682 | 0.072 | 1.59 |
| **FC-6/7-3TP** | | | | | |
| 07/06/95 | 85.2 | 255 | 414 | 71.9 | 46.6 |
| 07/07/95 | NC | 117 | 322 | 149 | NC |
| 07/10/95 | NC | 309 | 494 | NC | NC |
| 07/11/95 | 299 | 1000 | 1510 | 335 | 195 |
| **FC-6/7-9S** | | | | | |
| 07/05/95 | 0.052 | 0.027 | 0.148 | 0.072 | 0.025 |
| 07/07/95 | 0.696 | 1.53 | 2.61 | NC | 0.311 |
| 07/08/95 | 0.546 | 1.55 | 3.12 | 0.287 | 0.245 |

# Table 4-20
# (Continued)

| Date | Toluene ($\mu g/m^2$-min) | Tetrachloroethylene ($\mu g/m^2$-min) | Ethylbenzene ($\mu g/m^2$-min) | Styrene ($\mu g/m^2$-min) | p-Xylene+m-Xylene ($\mu g/m^2$-min) |
|---|---|---|---|---|---|
| **FC-6/7-16T** | | | | | |
| 07/07/95 | 1810 | 20.3 | 479 | 337 | 636 |
| 07/10/95 | 2000 | 18.0 | 527 | 324 | 729 |
| 07/11/95 | 2690 | 25.1 | 725 | 487 | 948 |
| **FC-6/7-28S** | | | | | |
| 07/08/95 | 0.677 | 0.976 | 0.091 | 0.106 | 0.083 |
| 07/10/95 | 1.29 | 1.81 | 0.263 | 0.219 | 0.188 |
| 07/11/95 | 1.64 | 0.914 | 0.294 | 0.255 | 0.455 |
| **FC-6/7-3TP** | | | | | |
| 07/06/95 | 5320 | 1810 | 827 | 971 | 1390 |
| 07/07/95 | 3760 | 1040 | 437 | 416 | 915 |
| 07/10/95 | 7750 | 2720 | 932 | 934 | 1960 |
| 07/11/95 | 24300 | 9130 | 3850 | 4380 | 6290 |
| **FC-6/7-9S** | | | | | |
| 07/05/95 | 0.902 | 0.355 | 0.520 | 1.12 | 0.424 |
| 07/07/95 | 1.49 | 13.4 | 0.536 | 1.12 | 0.400 |
| 07/08/95 | 16.2 | 13.2 | 4.36 | 4.84 | 2.93 |

# Table 4-20
## (Continued)

| Date | o-Xylene ($\mu g/m^2$-min) | n-Nonane ($\mu g/m^2$-min) | n-Decane & p-Dichlorobenzene, ($\mu g/m^2$-min) | 1,2,4-Trimethylbenzene & t-Butylbenzene ($\mu g/m^2$-min) | TNMHC ($\mu g/m^2$-min) |
|---|---|---|---|---|---|
| **FC-6/7-16T** | | | | | |
| 07/07/95 | 228 | 612 | 1640 | 392 | 32800 |
| 07/10/95 | 235 | 660 | 1730 | 417 | 37100 |
| 07/11/95 | 333 | 921 | 2290 | 613 | 45200 |
| **FC-6/7-28S** | | | | | |
| 07/08/95 | 0.066 | NC | 0.303 | 0.044 | 99.4 |
| 07/10/95 | 0.188 | NC | 0.358 | 0.089 | 169 |
| 07/11/95 | 0.195 | 0.198 | 1.02 | 0.234 | 153 |
| **FC-6/7-3TP** | | | | | |
| 07/06/95 | 387 | 1220 | 2340 | 555 | 67900 |
| 07/07/95 | 283 | 859 | 1260 | 222 | 90900 |
| 07/10/95 | 603 | 1810 | 3170 | 494 | 157000 |
| 07/11/95 | 1860 | 5910 | 11900 | 2290 | 303000 |
| **FC-6/7-9S** | | | | | |
| 07/05/95 | 0.879 | 0.315 | 8.50 | 2.84 | 173 |
| 07/07/95 | 0.734 | 0.184 | 3.41 | 0.612 | 63.2 |
| 07/08/95 | 4.00 | 1.92 | 11.3 | 5.30 | 325 |

NC = Not Calculated

Note: Limitations of the reported data are given in Table 4-2.

## Table 4-21
## Emission Flux for $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Temporal Sampling of Landfill Surface at Section 6/7

| Date | $CH_4$ (g/m²-min) | $CO_2$ (g/m²-min) | O2 (g/m²-min) | $H_2S$ (μg/m²-min) |
|---|---|---|---|---|
| **FC-6/7-16T** | | | | |
| 07/07/95 | 9.46 | 16.3 | 1.58 | 6540 |
| 07/10/95 | 10.1 | 17.2 | 0.727 | 4840 |
| 07/11/95 | 11.6 | 22.1 | 1.73 | 7620 |
| **FC-6/7-28S** | | | | |
| 07/08/95 | 0.140 | 0.417 | 2.12 | 0.0 |
| 07/10/95 | 0.150 | 1.94 | 3.67 | 1.00 |
| 07/11/95 | 0.139 | 1.67 | 1.66 | 3.00 |
| **FC-6/7-3TP** | | | | |
| 07/06/95 | 17.0 | 31.9 | 1.22 | 955 |
| 07/07/95 | 13.2 | 26.7 | 2.73 | 886 |
| 07/10/95 | 31.8 | 56.2 | 3.59 | 845 |
| 07/11/95 | 70.5 | 13.3 | 2.50 | 2500 |
| **FC-6/7-9S** | | | | |
| 07/05/95 | 0.139 | 0.515 | 1.36 | 1.00 |
| 07/07/95 | 0.136 | 0.16 | 3.01 | 2.00 |
| 07/08/95 | 0.139 | 0.503 | 1.12 | 2.00 |

## Table 4-22
## Concentration of VOCs Detected in Surface Soils

| Compound | Concentration (µg/kg) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Section 1/9 | | | Section 2/8 | | | Section 3/4 | | | Section 6/7 | | |
| | Pt. 1 | Pt. 2 | Pt. 3 | V-014 | V-043 | V-077 | V-015 | V-028 | V-068 | Pt.1 | Pt. 2 | Pt. 3 |
| Acetone[a] | 7.84 | ND | ND | ND | ND | ND | ND | 5.47 | ND | ND | ND | ND |
| Trichlorofluoromethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.43 | ND |
| Methylene Chloride | 0.49 | 0.57 | 1.81 | 2.87 | 1.28 | 1.88 | 1.34 | 0.60 | 2.33 | 1.56 | 1.10 | 1.62 |
| Tetrachloroethylene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.91 | ND |
| Chlorobenzene | 2.64 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Dibromomethane | ND | ND | ND | 0.34 | ND | ND | ND | 0.36 | ND | ND | 0.61 | ND |
| 2-Hexanone | ND | ND | ND | ND | ND | ND | ND | 2.51 | ND | ND | ND | ND |

[a]Acetone values are suspect (see Table 4-2).

ND = Not Detected

Note: Soil samples from Sections 2/8 and 3/4 were collected near vents identified above each sample section. For other sections the samples were collected as follows:

Section 1/9:

- Pt. 1 - Collected near extraction well J-35
- Pt. 2 - Collected above gas plant, approximately 50 feet from combined headers sampling locations.
- Pt. 3 - Collected near vent 912, approximately 15 feet uphill from lower roadway.

Section 6/7:

- Pt. 1 - Collected adjacent to Flux point FC-6/7-1TP.
- Pt. 2 - Collected adjacent to Flux point FC-6/7-10S.
- Pt. 3 - Collected adjacent to Flux point FC-6/7-13S.

# Table 4-23
# Physical Property Measurement Data for Surface Soils

| Section | Sample | Property | | |
|---|---|---|---|---|
| | | Bulk Density ($g/cm^3$) | Particle Density ($g/cm^3$) | Moisture (wt. %) |
| 3/4 | OS-53-070595-R-327 | 1.68 | 2.41 | 14.72 |
| 3/4 | OS-53-070595-R-328 | 1.46 | 2.37 | 14.40 |
| 3/4 | OS-53-070595-R-329 | 1.63 | 2.47 | 11.38 |
| 2/8 | OS-52-070595-R-330 | 1.79 | 2.53 | 12.10 |
| 2/8 | OS-52-070595-R-331 | 1.62 | 2.48 | 16.58 |
| 2/8 | OS-52-070595-R-332 | 1.61 | 2.46 | 11.47 |
| 2/8 | OS-52-070595-R-333 | 1.81 | 2.33 | 11.44 |
| 6/7 | OS-56-070695-R-334 | 1.87 | 2.50 | 15.66 |
| 6/7 | OS-56-070595-R-335 | 1.70 | 2.54 | 17.01 |
| 6/7 | OS-56-070595-R-336 | 1.88 | 2.65 | 11.29 |
| 6/7 | OS-56-070595-R-337 | 1.87 | 2.56 | 10.14 |
| 1/9 | OS-51-070795-R-338 | 1.29 | 2.50 | 12.29 |
| 1/9 | OS-51-070795-R-339 | 1.33 | 2.39 | 16.26 |
| 1/9 | OS-51-070795-R-340 | 1.63 | 2.43 | 10.93 |
| | | | | |
| 3/4 | Averages | 1.59 | 2.42 | 13.50 |
| 2/8 | Averages | 1.71 | 2.45 | 12.90 |
| 6/7 | Averages | 1.83 | 2.56 | 13.53 |
| 1/9 | Averages | 1.42 | 2.44 | 13.16 |
| Entire Landfill | Averages | 1.66 | 2.47 | 13.26 |

Note: Percent moisture data are on a dry weight basis.

**Table 4-24**
**Concentration of VOCs Detected in Landfill Seep Samples**

| Compound | Concentration ($\mu g/kg$) | | |
|---|---|---|---|
| | Section 2/8 | Section 3/4 | Section 6/7 |
| Chloroethane | ND | ND | 4.33 |
| Acetone | ND | ND | 508.00 |
| Methylene Chloride | 0.87 | 1.24 | 39.43 |
| 1,1-Dichloroethane | ND | ND | 5.02 |
| 2-Butanone | ND | ND | 1697.67 |
| Methylisobutylketone | ND | ND | 3.07 |
| Toluene | ND | ND | 19.90 |
| Tetrachloroethylene | ND | ND | 0.25 |
| p-Xylene + m-Xylene | ND | ND | 3.04 |
| o-Xylene | ND | ND | 1.60 |
| Trichloroethene | ND | ND | 0.51 |
| Dibromomethane | 0.65 | 0.35 | 0.36 |

ND = Not Detected

# Table 4-25
## Summary Statistics for Gas Collection Header Concentration Data

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Carbon Dioxide | 0.20% | 100 | 18 | 29.8% | 40.3% | 37.9% | 37.1% | 3.13% | 35.6% | 38.7% |
| Methane | 0.08% | 100 | 18 | 44.0% | 60.0% | 57.3% | 55.6% | 4.51% | 53.4% | 57.9% |
| Oxygen | 0.14% | 61.1 | 18 | ND | 5.40% | 0.45% | 0.99% | 1.51% | 0.24% | 1.75% |
| 1,1,1-Trichloroethane | 0.18 | 100 | 12 | 0.13 | 0.34 | 0.17 | 0.19 | 0.06 | 0.15 | 0.23 |
| 1,2,3-Trimethylbenzene | 0.25 | 100 | 12 | 1.64 | 2.19 | 1.90 | 1.90 | 0.13 | 1.82 | 1.98 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.25 | 100 | 12 | 4.76 | 5.77 | 4.97 | 5.06 | 0.31 | 4.87 | 5.26 |
| 1-Octene | 0.25 | 100 | 12 | 0.17 | 0.31 | 0.23 | 0.24 | 0.06 | 0.20 | 0.27 |
| 2,2,4-Trimethylpentane | 0.25 | 100 | 12 | 0.20 | 0.40 | 0.31 | 0.30 | 0.09 | 0.24 | 0.36 |
| 2,3,4-Trimethylpentane | 0.25 | 100 | 12 | 0.10 | 0.19 | 0.10 | 0.12 | 0.03 | 0.10 | 0.13 |
| 2-Methyl-2-Butene | 0.25 | 100 | 12 | 0.24 | 0.43 | 0.28 | 0.29 | 0.05 | 0.26 | 0.32 |
| 3-Methylhexane | 0.25 | 100 | 12 | 0.29 | 0.47 | 0.38 | 0.37 | 0.08 | 0.32 | 0.42 |
| Benzene | 0.04 | 100 | 12 | 0.72 | 1.29 | 0.95 | 0.93 | 0.18 | 0.82 | 1.04 |
| Acetone | 0.25 | 100 | 12 | 0.58 | 11.6 | 5.31 | 6.09 | 3.66 | 3.76 | 8.41 |
| Hexachloro-1,3-Butadiene | 0.25 | 100 | 12 | 0.38 | 0.61 | 0.48 | 0.48 | 0.06 | 0.44 | 0.52 |
| Ethylbenzene | 0.04 | 100 | 12 | 3.75 | 5.54 | 4.64 | 4.71 | 0.59 | 4.34 | 5.09 |
| Ethane | 0.25 | 100 | 12 | 180 | 251 | 219 | 223 | 21.7 | 209 | 236 |
| Dichlorodifluoromethane | 0.25 | 100 | 12 | 0.70 | 1.89 | 1.41 | 1.27 | 0.38 | 1.03 | 1.51 |
| Cyclohexane | 0.25 | 100 | 12 | 0.29 | 0.70 | 0.46 | 0.45 | 0.13 | 0.37 | 0.53 |
| Cumene | 0.25 | 100 | 12 | 0.55 | 0.68 | 0.63 | 0.63 | 0.04 | 0.60 | 0.66 |
| Chloromethane/Halocarbon 114 | 0.44 | 100 | 12 | 0.17 | 0.32 | 0.21 | 0.23 | 0.05 | 0.19 | 0.26 |
| Chlorobenzene | 0.03 | 100 | 12 | 0.89 | 1.45 | 1.14 | 1.15 | 0.22 | 1.01 | 1.30 |
| Isopentane | 0.25 | 100 | 12 | 1.97 | 7.47 | 3.30 | 3.76 | 1.91 | 2.55 | 4.98 |
| Isohexane | 0.25 | 100 | 12 | 0.20 | 0.28 | 0.26 | 0.25 | 0.03 | 0.23 | 0.26 |
| Isoheptane + 2,3-Dimethylpentane | 0.25 | 100 | 12 | 0.35 | 0.56 | 0.51 | 0.46 | 0.09 | 0.40 | 0.52 |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| Isobutylbenzene | 0.25 | 100 | 12 | 0.79 | 0.90 | 0.88 | 0.86 | 0.04 | 0.84 | 0.89 |
| Isobutene + 1-Butene | 0.25 | 100 | 12 | 0.67 | 1.14 | 0.94 | 0.92 | 0.18 | 0.80 | 1.03 |
| Isobutane | 0.25 | 100 | 12 | 7.11 | 9.55 | 8.36 | 8.24 | 0.73 | 7.78 | 8.71 |
| Hexanal | 0.25 | 100 | 12 | 0.24 | 0.61 | 0.34 | 0.37 | 0.13 | 0.28 | 0.45 |
| Benzyl Chloride &m-Dichlorobenzene | 0.16 | 100 | 12 | 1.33 | 2.23 | 1.92 | 1.88 | 0.23 | 1.73 | 2.03 |
| b-Pinene | 0.25 | 100 | 12 | 0.19 | 1.67 | 0.60 | 0.70 | 0.39 | 0.45 | 0.95 |
| a-Pinene | 0.25 | 100 | 12 | 5.39 | 9.70 | 8.03 | 7.85 | 1.32 | 7.02 | 8.69 |
| Vinyl Chloride | 0.32 | 100 | 12 | 0.09 | 0.39 | 0.29 | 0.27 | 0.10 | 0.21 | 0.34 |
| Trichlorofluoromethane | 0.18 | 100 | 12 | 0.46 | 1.16 | 0.62 | 0.69 | 0.24 | 0.54 | 0.84 |
| Trichloroethene | 0.33 | 100 | 12 | 0.17 | 0.33 | 0.24 | 0.24 | 0.06 | 0.20 | 0.28 |
| Total Unidentified VOCs | 0.25 | 100 | 12 | 115 | 156 | 134 | 134 | 12.2 | 127 | 142 |
| Toluene | 0.02 | 100 | 12 | 11.4 | 17.8 | 14.6 | 14.6 | 2.77 | 12.80 | 16.30 |
| Tetrachloroethylene | 0.36 | 100 | 12 | 0.34 | 0.84 | 0.56 | 0.57 | 0.22 | 0.43 | 0.71 |
| t-2-Pentene | 0.25 | 100 | 12 | 2.16 | 3.25 | 2.27 | 2.37 | 0.30 | 2.18 | 2.56 |
| p-Xylene + m-Xylene | 0.2 | 100 | 12 | 4.81 | 6.91 | 6.03 | 5.97 | 0.91 | 5.39 | 6.55 |
| p-Ethyltoluene | 0.07 | 100 | 12 | 1.60 | 2.14 | 2.06 | 2.01 | 0.16 | 1.91 | 2.11 |
| p-Diethylbenzene | 0.25 | 100 | 12 | 2.18 | 3.45 | 2.33 | 2.67 | 0.52 | 2.34 | 3.01 |
| o-Xylene | 0.05 | 100 | 12 | 1.77 | 2.68 | 2.24 | 2.17 | 0.29 | 1.98 | 2.35 |
| o-Ethyltoluene | 0.25 | 100 | 12 | 3.07 | 3.70 | 3.43 | 3.43 | 0.22 | 3.29 | 3.57 |
| o-Dichlorobenzene | 0.14 | 100 | 12 | 1.95 | 2.29 | 2.22 | 2.17 | 0.11 | 2.10 | 2.23 |
| n-Undecane | 0.25 | 100 | 12 | 0.65 | 7.98 | 6.17 | 5.5 | 2.30 | 4.04 | 6.96 |
| n-Propylbenzene | 0.25 | 100 | 12 | 1.77 | 2.36 | 2.10 | 2.09 | 0.22 | 1.95 | 2.23 |
| n-Pentane | 0.25 | 100 | 12 | 0.58 | 1.70 | 0.86 | 0.97 | 0.42 | 0.70 | 1.23 |
| n-Octane | 0.25 | 100 | 12 | 0.67 | 1.31 | 1.00 | 0.99 | 0.29 | 0.81 | 1.18 |
| n-Nonane | 0.25 | 100 | 12 | 2.90 | 4.15 | 3.57 | 3.57 | 0.55 | 3.22 | 3.92 |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| n-Hexane | 0.25 | 100 | 12 | 0.45 | 1.44 | 1.00 | 0.92 | 0.32 | 0.72 | 1.12 |
| n-Heptane | 0.25 | 100 | 12 | 0.50 | 0.83 | 0.75 | 0.67 | 0.14 | 0.58 | 0.75 |
| n-Decane & p-Dichlorobenzene | 0.1 | 100 | 12 | 12.7 | 14.7 | 14.2 | 14.0 | 0.70 | 13.5 | 14.4 |
| n-Butane | 0.25 | 100 | 12 | 3.25 | 4.30 | 3.96 | 3.80 | 0.41 | 3.55 | 4.06 |
| m-Ethyltoluene | 0.25 | 100 | 12 | 1.85 | 2.93 | 2.51 | 2.49 | 0.35 | 2.26 | 2.71 |
| m-Diethylbenzene | 0.25 | 100 | 12 | 0.63 | 1.82 | 1.51 | 1.46 | 0.32 | 1.26 | 1.66 |
| c-1,2-Dichloroethylene | 0.22 | 100 | 12 | 0.47 | 0.74 | 0.55 | 0.57 | 0.09 | 0.51 | 0.63 |
| TNMHC | 0.25 | 100 | 12 | 385 | 481 | 445 | 438 | 33.3 | 417 | 459 |
| Styrene | 0.04 | 100 | 12 | 1.45 | 2.65 | 2.10 | 2.02 | 0.49 | 1.71 | 2.33 |
| Propane | 0.25 | 100 | 12 | 10.5 | 15.3 | 13.3 | 13.0 | 1.96 | 11.8 | 14.3 |
| Neohexane | 0.25 | 100 | 12 | 0.10 | 0.52 | 0.12 | 0.17 | 0.14 | 0.08 | 0.26 |
| Naphthalene | 0.25 | 100 | 12 | 0.21 | 1.08 | 0.82 | 0.80 | 0.23 | 0.65 | 0.94 |
| Methylene Chloride | 0.31 | 100 | 12 | 0.25 | 0.92 | 0.53 | 0.55 | 0.18 | 0.43 | 0.66 |
| Methylcyclohexane | 0.25 | 100 | 12 | 0.26 | 0.85 | 0.41 | 0.52 | 0.19 | 0.40 | 0.64 |
| Limonene | 0.25 | 100 | 12 | 30.1 | 39.0 | 36.0 | 35.4 | 3.39 | 33.2 | 37.5 |
| 3-Methylheptane | 0.25 | 100 | 12 | 0.17 | 0.36 | 0.22 | 0.23 | 0.07 | 0.19 | 0.28 |
| 2,2,5-Trimethylhexane | 0.25 | 100 | 12 | 0.23 | 0.33 | 0.29 | 0.29 | 0.03 | 0.27 | 0.30 |
| 1,3,5-Trimethylbenzene | 0.07 | 100 | 12 | 1.26 | 2.00 | 1.78 | 1.76 | 0.23 | 1.61 | 1.90 |
| 1,2,4-Trichlorobenzene | 0.25 | 100 | 12 | 0.75 | 1.04 | 0.89 | 0.88 | 0.10 | 0.82 | 0.95 |
| 2-Methyl-1-Butene | 0.25 | 91.67 | 12 | NC | 0.32 | 0.22 | 0.22 | 0.09 | 0.17 | 0.28 |
| Isoprene | 0.25 | 91.67 | 12 | NC | 0.21 | 0.17 | 0.17 | 0.03 | 0.15 | 0.18 |
| n-Butylbenzene | 0.25 | 91.67 | 12 | NC | 1.64 | 1.47 | 1.38 | 0.42 | 1.11 | 1.64 |
| 1,1,2,2-Tetrachloroethane | 0.32 | 83.33 | 12 | NC | 0.03 | 0.02 | 0.03 | 0.03 | 0.02 | 0.05 |
| 1,1-Dichloroethane | 0.19 | 83.33 | 12 | NC | 0.64 | 0.19 | 0.34 | 0.23 | 0.20 | 0.49 |
| Methylcyclopentane | 0.25 | 83.33 | 12 | NC | 0.34 | 0.21 | 0.23 | 0.08 | 0.18 | 0.28 |
| Cyclopentane | 0.25 | 83.33 | 12 | NC | 0.33 | 0.24 | 0.24 | 0.09 | 0.18 | 0.29 |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| Chloroethane | 0.22 | 83.33 | 12 | NC | 0.15 | 0.12 | 0.13 | 0.04 | 0.11 | 0.16 |
| Dichlorotoluene | 0.25 | 75 | 12 | NC | 1.87 | 0.98 | 0.89 | 0.54 | 0.55 | 1.24 |
| 1-Hexene | 0.25 | 66.67 | 12 | NC | 0.46 | 0.15 | 0.17 | 0.11 | 0.10 | 0.24 |
| 1-Undecene | 0.25 | 66.67 | 12 | NC | 2.33 | 1.89 | 1.37 | 0.97 | 0.76 | 1.99 |
| Freon 113 | 0.87 | 58.33 | 12 | NC | 0.06 | 0.03 | 0.25 | 0.30 | 0.06 | 0.45 |
| 2,5-Dimethylhexane | 0.25 | 50 | 12 | NC | 0.32 | 0.05 | 0.18 | 0.07 | 0.13 | 0.22 |
| 3-Methyl-1-Butene | 0.25 | 50 | 12 | NC | 0.28 | 0.05 | 0.13 | 0.08 | 0.08 | 0.18 |
| 1-Methylcyclohexene | 0.25 | 41.67 | 12 | NC | 0.52 | NC | 0.19 | 0.14 | 0.10 | 0.28 |
| t-2-Butene | 0.25 | 41.67 | 12 | NC | 0.17 | NC | 0.12 | 0.05 | 0.09 | 0.15 |
| t-3-Heptene | 0.25 | 41.67 | 12 | NC | 0.35 | NC | 0.19 | 0.08 | 0.13 | 0.24 |
| 1,1-Dichloroethylene | 3.15 | 33.33 | 12 | NC | 0.66 | NC | 1.27 | 1.08 | 0.58 | 1.95 |
| t-2-Hexene | 0.25 | 33.33 | 12 | NC | 0.71 | NC | 0.24 | 0.22 | 0.10 | 0.38 |
| 2-Methylheptane | 0.25 | 33.33 | 12 | NC | 0.14 | NC | 0.14 | 0.03 | 0.13 | 0.16 |
| 2,2,3-Trimethylpentane | 0.25 | 33.33 | 12 | NC | 0.39 | NC | 0.16 | 0.10 | 0.09 | 0.22 |
| 1-Pentene | 0.25 | 25 | 12 | NC | 0.23 | NC | 0.16 | 0.08 | 0.11 | 0.22 |
| 2-Methyl-2-Pentene | 0.25 | 25 | 12 | NC | 0.19 | NC | 0.12 | 0.08 | 0.07 | 0.17 |
| 3-Methylpentane | 0.25 | 25 | 12 | NC | 15.6 | NC | 2.03 | 4.76 | 0.00 | 5.05 |
| 1-Heptene | 0.25 | 16.67 | 12 | NC | 0.20 | NC | 0.14 | 0.07 | 0.10 | 0.19 |
| Neopentane | 0.25 | 16.67 | 12 | NC | 0.12 | NC | 0.12 | 0.06 | 0.08 | 0.15 |
| c-2-Butene | 0.25 | 16.67 | 12 | NC | 0.21 | NC | 0.13 | 0.06 | 0.09 | 0.17 |
| 2,4-Dimethylpentane | 0.25 | 16.67 | 12 | NC | 0.25 | NC | 0.12 | 0.08 | 0.07 | 0.17 |
| 1,3-Butadiene | 0.25 | 8.33 | 12 | NC | 3.98 | NC | 0.44 | 1.12 | 0.00 | 1.15 |
| t-2-Heptene | 0.25 | 8.33 | 12 | NC | 0.07 | NC | 0.15 | 0.08 | 0.10 | 0.20 |
| p-Isopropyltoluene | 0.25 | 8.33 | 12 | NC | 13.14 | NC | 1.22 | 3.75 | 0.00 | 3.61 |
| c-2-Pentene | 0.25 | 8.33 | 12 | NC | 0.33 | NC | 0.14 | 0.09 | 0.08 | 0.19 |
| Methylisobutylketone | 0.25 | 8.33 | 12 | NC | 0.10 | NC | 0.13 | 0.09 | 0.07 | 0.18 |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-Decene | 0.25 | 8.33 | 12 | NC | 0.38 | NC | 0.19 | 0.09 | 0.13 | 0.24 |
| 1,1,2-Trichloroethane | 0.27 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1,2-Dibromoethane | 0.28 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1,4-Dioxane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1-Propanol | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2,4,4-Trimethyl-1-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2-Butanone | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2-Methyl-1-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2-Ethyl-1-Butene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Bromoform | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Bromodichloromethane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Bromochloromethane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Benzaldehyde | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Acrylonitrile | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Acetaldehyde | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 4-Nonene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 4-Methyl-1-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| t-4-Methyl-2-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| t-1,3-Dichloropropene | 0.13 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| t-1,2-Dichloroethylene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Hexene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Heptene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Octene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Hexene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-1,3-Dichloropropene | 0.77 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Vinyl Bromide | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Vinyl Acetate | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Trichloroethylene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| p-Chlorotoluene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| o-Chlorotoluene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| m-Chlorotoluene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-4-Methyl-2-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Methyl-2-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Indene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Indan | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Heptanal | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Freon 23 | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Ethylene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Ethanol & Acetonitrile | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Diethyl Ether &2-Propanol | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Dibromochloromethane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Methylcyclopentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Methyl t-Butylether | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Methanol (+) | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Cyclopentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Cyclohexene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Chloroprene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Chloroform | 0.19 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Chlorodifluoromethane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Carbon Tetrachloride | 0.36 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Butyraldehyde | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| Bromomethane | 0.37 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |

# Table 4-25
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3,5,5-Trimethylhexene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2,4-4-Trimethyl-2-Pentene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 2,3-Dimethylbutane | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1-Nonene | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1-Butanol | 0.25 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1,2-Dichloroethane | 0.37 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |
| 1,2-Dichloropropane | 0.22 | 0 | 12 | NC | NC | NC | NC | NC | NC | NC |

ND = Not Detected
NC = Not Calculated

# Table 4-26
# Concentration and Emissions of Select VOCs from Temporal Sampling of Landfill Gas Collection System Headers

| Date | Flowrate (m3/min) | Vinyl Chloride | | 1,1-Dichloroethylene | | Methylene Chloride | | 1,1-Dichloroethane | | c-1,2-Dichloroethylene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| **North field** | | | | | | | | | | | |
| 07/03/95 | 125 | 0.25 | 1,300 | ND | NC | 0.92 | 6,650 | 0.19 | 1,620 | 0.51 | 4,170 |
| 07/05/95 | 100 | 0.21 | 911 | 0.22 | 1,440 | 0.82 | 4,770 | ND | NC | 0.47 | 3,100 |
| 07/06/95 | 113 | 0.21 | 1,020 | ND | NC | 0.63 | 4,090 | 0.18 | 1,370 | 0.48 | 3,580 |
| 07/07/95 | 106 | 0.09 | 409 | ND | NC | 0.41 | 2,520 | 0.19 | 1,340 | 0.47 | 3,310 |
| 07/08/95 | 111 | 0.12 | 583 | ND | NC | 0.51 | 3,300 | 0.19 | 1,400 | 0.51 | 3,720 |
| 07/10/95 | 109 | 0.25 | 1,170 | ND | NC | 0.58 | 3,630 | 0.18 | 1,340 | 0.48 | 3,440 |
| **South field** | | | | | | | | | | | |
| 07/03/95 | 378 | 0.35 | 5,640 | 0.66 | 16,300 | 0.47 | 10,200 | ND | NC | 0.61 | 15,100 |
| 07/05/95 | 195 | 0.37 | 3,020 | 0.01 | 172 | 0.46 | 5,200 | 0.60 | 7,920 | 0.66 | 8,480 |
| 07/06/95 | 185 | 0.39 | 3,050 | 0.02 | 216 | 0.38 | 4,040 | 0.64 | 8,030 | 0.74 | 9,000 |
| 07/07/95 | 194 | 0.35 | 2,860 | ND | NC | 0.55 | 6,180 | 0.62 | 8,090 | 0.62 | 7,920 |
| 07/08/95 | 215 | 0.36 | 3,320 | ND | NC | 0.25 | 3,120 | 0.57 | 8,210 | 0.59 | 8,400 |
| 07/10/95 | 197 | 0.32 | 2,660 | ND | NC | 0.56 | 6,380 | 0.56 | 7,360 | 0.66 | 8,550 |

# Table 4-26
## (Continued)

| Date | Flowrate (m3/min) | 1,1,1-Trichloroethane (ppm) | 1,1,1-Trichloroethane (ug/sec) | Benzene (ppm) | Benzene (ug/sec) | Toluene (ppm) | Toluene (ug/sec) | Chlorobenzene (ppm) | Chlorobenzene (ug/sec) | Ethylbenzene (ppm) | Ethylbenzene (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North field** | | | | | | | | | | | |
| 07/03/95 | 125 | 0.34 | 3,810 | 0.85 | 5,610 | 11.98 | 93,500 | 0.96 | 9,160 | 4.16 | 37,400 |
| 07/05/95 | 100 | 0.25 | 2,240 | 0.74 | 3,930 | 11.72 | 73,800 | 0.94 | 7,240 | 4.60 | 33,400 |
| 07/06/95 | 113 | 0.19 | 1,940 | 0.98 | 5,880 | 12.32 | 87,300 | 0.96 | 8,340 | 4.75 | 38,800 |
| 07/07/95 | 106 | 0.21 | 2,000 | 0.73 | 4,140 | 11.38 | 75,900 | 0.89 | 7,300 | 3.75 | 28,900 |
| 07/08/95 | 111 | 0.20 | 1,990 | 0.72 | 4,250 | 12.00 | 83,500 | 0.94 | 7,980 | 4.03 | 32,300 |
| 07/10/95 | 109 | 0.17 | 1,640 | 0.80 | 4,610 | 12.24 | 83,400 | 0.96 | 8,030 | 4.50 | 35,400 |
| **South field** | | | | | | | | | | | |
| 07/03/95 | 378 | 0.16 | 5,470 | 0.99 | 19,800 | 17.84 | 422,000 | 1.32 | 38,200 | 5.49 | 150,000 |
| 07/05/95 | 195 | 0.16 | 2,850 | 0.99 | 10,300 | 16.98 | 207,000 | 1.37 | 20,500 | 5.54 | 78,000 |
| 07/06/95 | 185 | 0.17 | 2,850 | 1.00 | 9,840 | 17.12 | 199,000 | 1.45 | 20,700 | 5.01 | 67,100 |
| 07/07/95 | 194 | 0.15 | 2,670 | 1.17 | 12,000 | 16.82 | 205,000 | 1.36 | 20,200 | 5.50 | 77,200 |
| 07/08/95 | 215 | 0.13 | 2,630 | 0.92 | 10,500 | 17.45 | 235,000 | 1.33 | 21,800 | 4.56 | 70,700 |
| 07/10/95 | 197 | 0.16 | 2,780 | 1.29 | 13,500 | 16.95 | 209,000 | 1.37 | 20,600 | 4.67 | 66,500 |

# Table 4-26
# (Continued)

| Date | Flowrate (m3/min) | p-Xylene + m-Xylene (ppm) | p-Xylene + m-Xylene (ug/sec) | Styrene (ppm) | Styrene (ug/sec) | 1,1,2,2-Tetrachloroethane (ppm) | 1,1,2,2-Tetrachloroethane (ug/sec) | o-Xylene (ppm) | o-Xylene (ug/sec) | n-Nonane (ppm) | n-Nonane (ug/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North field** | | | | | | | | | | | |
| 07/03/95 | 125 | 5.14 | 46,300 | 1.50 | 13,200 | 0.02 | 337 | 1.89 | 17,100 | 3.03 | 33,000 |
| 07/05/95 | 100 | 5.01 | 36,400 | 1.52 | 10,800 | 0.02 | 263 | 1.86 | 13,500 | 3.03 | 26,600 |
| 07/06/95 | 113 | 5.38 | 44,000 | 1.81 | 14,500 | 0.03 | 362 | 2.15 | 17,500 | 3.17 | 31,300 |
| 07/07/95 | 106 | 4.81 | 37,000 | 1.45 | 10,900 | 0.02 | 238 | 1.77 | 13,700 | 2.90 | 26,900 |
| 07/08/95 | 111 | 5.14 | 41,200 | 1.57 | 12,300 | 0.02 | 206 | 1.90 | 15,200 | 3.06 | 29,700 |
| 07/10/95 | 109 | 5.16 | 40,600 | 1.55 | 12,000 | 0.03 | 311 | 1.93 | 15,100 | 3.10 | 29,400 |
| **South field** | | | | | | | | | | | |
| 07/03/95 | 378 | 6.75 | 184,000 | 2.46 | 65,800 | 0.02 | 733 | 2.35 | 64,200 | 4.07 | 134,000 |
| 07/05/95 | 195 | 6.91 | 97,300 | 2.48 | 34,200 | 0.02 | 507 | 2.40 | 33,700 | 4.15 | 70,500 |
| 07/06/95 | 185 | 6.89 | 92,300 | 2.65 | 34,700 | 0.02 | 459 | 2.68 | 35,900 | 4.11 | 66,400 |
| 07/07/95 | 194 | 6.91 | 97,100 | 2.38 | 32,800 | 0.02 | 435 | 2.36 | 33,100 | 4.13 | 70,000 |
| 07/08/95 | 215 | 6.67 | 103,000 | 2.52 | 38,300 | ND | NC | 2.32 | 35,900 | 3.96 | 74,200 |
| 07/10/95 | 197 | 6.88 | 97,900 | 2.39 | 33,300 | ND | NC | 2.38 | 33,800 | 4.15 | 71,300 |

# Table 4-26
# (Continued)

| Date | Flowrate (m3/min) | 1,2,4-Trichlorobenzene (ppm) | 1,2,4-Trichlorobenzene (ug/sec) | Benzyl Chloride & m-Dichlorobenzene (ppm) | Benzyl Chloride & m-Dichlorobenzene (ug/sec) | 1,2,4-Trimethylbenzene & t-Butylbenzene (ppm) | 1,2,4-Trimethylbenzene & t-Butylbenzene (ug/sec) | Trichloroethene (ppm) | Trichloroethene (ug/sec) | TNMHC (ppm) | TNMHC (g/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North field** | | | | | | | | | | | |
| 07/03/95 | 125 | 0.92 | 14,200 | 1.75 | 20,300 | 5.04 | 54,300 | 0.20 | 2240 | 400 | 2.92 |
| 07/05/95 | 100 | 0.90 | 11,100 | 1.77 | 16,600 | 4.96 | 43,100 | 0.19 | 1690 | 406 | 2.39 |
| 07/06/95 | 113 | 1.01 | 14,100 | 2.23 | 23,500 | 5.77 | 56,500 | 0.17 | 1750 | 449 | 2.97 |
| 07/07/95 | 106 | 1.03 | 13,500 | 1.71 | 17,000 | 4.79 | 44,200 | 0.18 | 1760 | 385 | 2.40 |
| 07/08/95 | 111 | 0.92 | 12,600 | 1.85 | 19,100 | 5.07 | 48,700 | 0.18 | 1790 | 410 | 2.66 |
| 07/10/95 | 109 | 1.04 | 13,900 | 2.09 | 21,200 | 5.58 | 52,500 | 0.19 | 1880 | 414 | 2.64 |
| **South field** | | | | | | | | | | | |
| 07/03/95 | 378 | 0.79 | 36,900 | 1.89 | 66,600 | 4.98 | 163,000 | 0.27 | 8980 | 470 | 10.4 |
| 07/05/95 | 195 | 0.75 | 18,100 | 1.97 | 35,800 | 5.07 | 85,400 | 0.28 | 4870 | 481 | 5.48 |
| 07/06/95 | 185 | 0.82 | 18,900 | 1.33 | 22,900 | 4.90 | 78,600 | 0.32 | 5320 | 470 | 5.09 |
| 07/07/95 | 194 | 0.78 | 18,700 | 1.95 | 35,300 | 4.90 | 82,500 | 0.33 | 5680 | 466 | 5.30 |
| 07/08/95 | 215 | 0.88 | 23,300 | 1.96 | 39,100 | 4.76 | 88,300 | 0.27 | 5110 | 441 | 5.53 |
| 07/10/95 | 197 | 0.77 | 18,700 | 2.07 | 38,000 | 4.91 | 83,700 | 0.30 | 5360 | 465 | 5.36 |

ND = Not Detected
NC = Not Calculated

# Table 4-27
## Concentration and Emissions of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Temporal Sampling of Landfill Gas Collection System Headers

| Date | Flow Rate ($m^3$/min) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (g/sec) | (ppm) | (g/sec) |
| **North Field** | | | | | | | | | | | |
| 07/03/95 | 125 | 40.3 | 1500 | 57.8 | 784 | 0.0 | 0.0 | 67.00 | 0.193 | NM | NM |
| 07/05/95 | 100 | 33.5 | 1010 | 47.7 | 522 | 3.0 | 65.6 | 68.00 | 0.158 | NM | NM |
| 07/06/95 | 113 | 38.8 | 1310 | 56.5 | 696 | 0.0 | 0.0 | 71.40 | 0.187 | NM | NM |
| 07/07/95 | 106 | 40.0 | 1270 | 59.0 | 684 | 0.0 | 0.0 | 84.20 | 0.208 | NM | NM |
| 07/08/95 | 111 | 35.1 | 1170 | 55.9 | 676 | 1.2 | 29.0 | 89.20 | 0.230 | 1.18 | 0.018 |
| 7/10/95 | 109 | 37.6 | 1220 | 59.0 | 699 | 0.0 | 0.0 | 56.24 | 0.142 | 0.85 | 0.013 |
| 7/11/95 | 331 | 36.3 | 3590 | 56.8 | 2040 | 0.4 | 28.8 | 67.10 | 0.514 | 0.21 | 0.009 |
| 07/12/95 | 95.5 | 38.0 | 1090 | 57.5 | 597 | 0.5 | 10.4 | 65.20 | 0.144 | 0.63 | 0.008 |
| 07/13/95 | 96.6 | 31.3 | 905 | 48.3 | 508 | 3.5 | 73.6 | 61.80 | 0.138 | 0.85 | 0.011 |
| **South Field** | | | | | | | | | | | |
| 07/03/95 | 378 | 40.2 | 4540 | 59.0 | 2430 | 0.0 | 0.0 | 100.00 | 0.875 | NM | NM |
| 07/05/95 | 195 | 37.4 | 2180 | 52.5 | 1110 | 1.8 | 76.3 | 88.80 | 0.401 | NM | NM |
| 07/06/95 | 185 | 39.1 | 2170 | 56.0 | 1130 | 0.5 | 20.2 | 85.10 | 0.365 | NM | NM |
| 07/07/95 | 194 | 38.1 | 2220 | 58.8 | 1240 | 0.0 | 0.0 | 93.20 | 0.420 | NM | NM |
| 07/08/95 | 215 | 39.8 | 2560 | 60.0 | 1400 | 0.0 | 0.0 | 81.20 | 0.404 | 0.94 | 0.028 |
| 7/10/95 | 197 | 37.8 | 2230 | 57.9 | 1240 | 0.3 | 12.9 | 90.04 | 0.411 | 0.72 | 0.019 |
| 7/11/95 | 177 | 37.7 | 2000 | 57.2 | 1100 | 0.7 | 27.0 | 94.90 | 0.389 | 0.17 | 0.004 |
| 07/12/95 | 168 | 38.6 | 1940 | 57.4 | 1050 | 0.6 | 21.9 | 90.39 | 0.351 | 0.70 | 0.016 |
| 07/13/95 | 183 | 28.9 | 1580 | 44.0 | 875 | 5.4 | 215 | 76.80 | 0.325 | 0.63 | 0.016 |

NM = Not Measured

# Table 4-28
# Summary Statistics for Gas Extraction Wells - Section 1/9

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| Carbon Dioxide | 0.20% | 100 | 25 | 13.0% | 43.4% | 30.0% | 30.0% | 9.65% | 26.0% | 34.0% |
| Methane | 0.08% | 100 | 25 | 16.9% | 56.9% | 44.1% | 42.0% | 12.1% | 37.0% | 47.0% |
| Oxygen | 0.14% | 100 | 25 | 0.60% | 14.9% | 5.20% | 5.72% | 4.32% | 3.94% | 7.51% |
| 1,2,4-Trichlorobenzene | 0.25 | 100 | 25 | 0.09 | 1.84 | 0.55 | 0.61 | 0.45 | 0.42 | 0.79 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.25 | 100 | 25 | 1.24 | 10.1 | 3.20 | 3.71 | 1.88 | 2.94 | 4.49 |
| Benzene | 0.04 | 100 | 25 | 0.16 | 4.06 | 0.63 | 0.83 | 0.75 | 0.52 | 1.14 |
| Benzyl Chloride &m-Dichlorobenzene | 0.16 | 100 | 25 | 0.32 | 4.91 | 0.87 | 1.17 | 0.97 | 0.77 | 1.56 |
| 1,3,5-Trimethylbenzene | 0.07 | 100 | 25 | 0.10 | 3.70 | 1.63 | 1.50 | 0.89 | 1.13 | 1.87 |
| Chlorobenzene | 0.03 | 100 | 25 | 0.13 | 4.26 | 0.60 | 1.18 | 1.07 | 0.74 | 1.62 |
| Ethane | 0.25 | 100 | 25 | 124 | 311 | 218 | 210 | 39 | 193 | 226 |
| Hexachloro-1,3-Butadiene | 0.25 | 100 | 25 | 0.11 | 0.89 | 0.36 | 0.38 | 0.18 | 0.30 | 0.45 |
| Ethylbenzene | 0.04 | 100 | 25 | 1.00 | 10.1 | 3.60 | 3.79 | 2.08 | 2.93 | 4.65 |
| n-Heptane | 0.25 | 100 | 25 | 0.06 | 3.11 | 0.32 | 0.72 | 0.77 | 0.40 | 1.04 |
| n-Decane & p-Dichlorobenzene | 0.10 | 100 | 25 | 3.46 | 32.9 | 10.2 | 11.4 | 5.89 | 8.92 | 13.8 |
| m-Ethyltoluene | 0.25 | 100 | 25 | 0.64 | 3.64 | 1.57 | 1.76 | 0.77 | 1.45 | 2.08 |
| m-Diethylbenzene | 0.25 | 100 | 25 | 0.53 | 6.25 | 1.23 | 1.63 | 1.43 | 1.04 | 2.22 |
| b-Pinene | 0.25 | 100 | 25 | 0.06 | 3.37 | 0.71 | 0.89 | 0.88 | 0.52 | 1.25 |
| a-Pinene | 0.25 | 100 | 25 | 1.36 | 19.8 | 6.38 | 6.67 | 4.10 | 4.97 | 8.36 |
| Total Unidentified VOCs | 0.25 | 100 | 25 | 24.1 | 324 | 115 | 120 | 71.4 | 90.6 | 150 |
| Toluene | 0.02 | 100 | 25 | 2.29 | 41.1 | 9.27 | 15.4 | 11.8 | 10.5 | 20.3 |
| p-Xylene + m-Xylene | 0.20 | 100 | 25 | 1.00 | 13.2 | 3.69 | 5.02 | 3.24 | 3.68 | 6.36 |
| p-Ethyltoluene | 0.07 | 100 | 25 | 0.41 | 4.66 | 1.42 | 1.49 | 0.83 | 1.15 | 1.84 |
| p-Diethylbenzene | 0.25 | 100 | 25 | 0.46 | 6.91 | 1.50 | 2.10 | 1.73 | 1.39 | 2.82 |
| o-Xylene | 0.05 | 100 | 25 | 0.41 | 5.29 | 1.44 | 1.95 | 1.44 | 1.35 | 2.54 |

# Table 4-28
## (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| o-Ethyltoluene | 0.25 | 100 | 25 | 0.58 | 7.73 | 2.31 | 2.54 | 1.49 | 1.93 | 3.16 |
| o-Dichlorobenzene | 0.14 | 100 | 25 | 0.42 | 3.91 | 1.24 | 1.41 | 0.84 | 1.07 | 1.76 |
| n-Undecane | 0.25 | 100 | 25 | 1.25 | 13.10 | 3.97 | 4.75 | 3.27 | 3.40 | 6.10 |
| n-Propylbenzene | 0.25 | 100 | 25 | 0.26 | 4.54 | 1.45 | 1.54 | 0.93 | 1.16 | 1.93 |
| n-Octane | 0.25 | 100 | 25 | 0.08 | 4.63 | 0.39 | 1.14 | 1.22 | 0.64 | 1.64 |
| n-Nonane | 0.25 | 100 | 25 | 0.50 | 8.84 | 2.66 | 3.27 | 2.31 | 2.32 | 4.22 |
| TNMHC | 0.25 | 100 | 25 | 127 | 969 | 363 | 395 | 188 | 317 | 472 |
| Styrene | 0.04 | 100 | 25 | 0.23 | 6.50 | 1.00 | 2.11 | 1.95 | 1.30 | 2.91 |
| Propane | 0.25 | 100 | 25 | 0.88 | 34.8 | 5.36 | 11.4 | 9.93 | 7.32 | 15.50 |
| Naphthalene | 0.25 | 100 | 25 | 0.05 | 2.05 | 0.33 | 0.52 | 0.51 | 0.31 | 0.73 |
| Limonene | 0.25 | 100 | 25 | 7.63 | 105 | 26.1 | 31.2 | 18.7 | 23.5 | 38.9 |
| Isobutylbenzene | 0.25 | 100 | 25 | 0.12 | 1.56 | 0.55 | 0.59 | 0.32 | 0.46 | 0.72 |
| Cumene | 0.25 | 100 | 25 | 0.11 | 1.59 | 0.37 | 0.43 | 0.29 | 0.31 | 0.55 |
| 1,2,3-Trimethylbenzene | 0.25 | 96 | 25 | NC | 3.79 | 0.97 | 1.23 | 0.76 | 0.92 | 1.55 |
| Isobutane | 0.25 | 96 | 25 | NC | 37.5 | 3.30 | 8.79 | 10.6 | 4.43 | 13.1 |
| 2,2,5-Trimethylhexane | 0.25 | 92 | 25 | NC | 0.57 | 0.16 | 0.21 | 0.14 | 0.15 | 0.27 |
| 3-Methylhexane | 0.25 | 92 | 25 | NC | 1.85 | 0.17 | 0.56 | 0.55 | 0.33 | 0.78 |
| Methylcyclohexane | 0.25 | 92 | 25 | NC | 2.34 | 0.16 | 0.64 | 0.74 | 0.34 | 0.95 |
| n-Butane | 0.25 | 92 | 25 | NC | 15.8 | 1.32 | 4.06 | 4.77 | 2.10 | 6.03 |
| Isobutene + 1-Butene | 0.25 | 88 | 25 | NC | 4.85 | 0.53 | 0.74 | 0.91 | 0.36 | 1.11 |
| Isoheptane + 2,3-Dimethylpentane | 0.25 | 88 | 25 | NC | 3.09 | 0.15 | 0.65 | 0.77 | 0.34 | 0.97 |
| c-1,2-Dichloroethylene | 0.22 | 88 | 25 | NC | 2.48 | 0.16 | 0.53 | 0.68 | 0.25 | 0.82 |
| 2-Methyl-1-Butene | 0.25 | 80 | 25 | NC | 5.07 | 0.16 | 0.48 | 0.99 | 0.07 | 0.89 |
| 2-Methyl-2-Butene | 0.25 | 80 | 25 | NC | 1.06 | 0.14 | 0.27 | 0.26 | 0.17 | 0.38 |
| t-2-Pentene | 0.25 | 80 | 25 | NC | 25.3 | 0.28 | 2.27 | 6.04 | 0.00 | 4.76 |

# Table 4-28
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| Isoprene | 0.25 | 80 | 25 | NC | 4.59 | 0.18 | 0.46 | 0.92 | 0.08 | 0.85 |
| Cyclohexane | 0.25 | 80 | 25 | NC | 1.65 | 0.21 | 0.47 | 0.48 | 0.28 | 0.67 |
| 1-Hexene | 0.25 | 76 | 25 | NC | 10.3 | 0.26 | 0.82 | 2.03 | 0.00 | 1.66 |
| Dichlorotoluene | 0.25 | 76 | 25 | NC | 3.79 | 0.28 | 0.70 | 0.85 | 0.35 | 1.05 |
| Hexanal | 0.25 | 76 | 25 | NC | 2.12 | 0.15 | 0.42 | 0.49 | 0.21 | 0.62 |
| 3-Methylheptane | 0.25 | 76 | 25 | NC | 1.06 | 0.10 | 0.28 | 0.27 | 0.17 | 0.39 |
| 1-Undecene | 0.25 | 72 | 25 | NC | 4.54 | 0.55 | 0.97 | 1.05 | 0.54 | 1.40 |
| Tetrachloroethylene | 0.36 | 68 | 25 | NC | 2.71 | 0.05 | 0.74 | 0.91 | 0.36 | 1.12 |
| n-Pentane | 0.25 | 68 | 25 | NC | 2.37 | 0.18 | 0.59 | 0.68 | 0.31 | 0.88 |
| 2,2,4-Trimethylpentane | 0.25 | 64 | 25 | NC | 1.47 | 0.20 | 0.41 | 0.40 | 0.25 | 0.58 |
| Trichloroethene | 0.33 | 64 | 25 | NC | 0.94 | 0.03 | 0.32 | 0.31 | 0.20 | 0.45 |
| Dichlorodifluoromethane | 0.25 | 64 | 25 | NC | 6.46 | 0.08 | 1.45 | 2.05 | 0.60 | 2.29 |
| 2,5-Dimethylhexane | 0.25 | 64 | 25 | NC | 0.56 | 0.14 | 0.22 | 0.13 | 0.17 | 0.28 |
| 1-Octene | 0.25 | 60 | 25 | NC | 0.78 | 0.11 | 0.27 | 0.20 | 0.18 | 0.35 |
| n-Butylbenzene | 0.25 | 60 | 25 | NC | 2.03 | 0.58 | 0.73 | 0.60 | 0.48 | 0.98 |
| n-Hexane | 0.25 | 60 | 25 | NC | 2.16 | 0.09 | 0.32 | 0.54 | 0.10 | 0.54 |
| Methylcyclopentane | 0.25 | 60 | 25 | NC | 0.99 | 0.07 | 0.33 | 0.30 | 0.20 | 0.45 |
| Isopentane | 0.25 | 60 | 25 | NC | 8.51 | 0.11 | 2.35 | 3.25 | 1.01 | 3.70 |
| 2,2,3-Trimethylpentane | 0.25 | 56 | 25 | NC | 0.32 | 0.15 | 0.15 | 0.08 | 0.12 | 0.18 |
| Chloromethane/Halocarbon 114 | 0.44 | 56 | 25 | NC | 0.97 | 0.04 | 0.27 | 0.23 | 0.18 | 0.37 |
| 1-Methylcyclohexene | 0.25 | 52 | 25 | NC | 1.01 | 0.05 | 0.25 | 0.23 | 0.16 | 0.35 |
| Neohexane | 0.25 | 52 | 25 | NC | 0.88 | 0.07 | 0.24 | 0.20 | 0.16 | 0.33 |
| Isohexane | 0.25 | 52 | 25 | NC | 0.76 | 0.07 | 0.23 | 0.22 | 0.14 | 0.32 |
| 2,3,4-Trimethylpentane | 0.25 | 48 | 25 | NC | 2.00 | NC | 0.45 | 0.50 | 0.24 | 0.65 |
| Vinyl Chloride | 0.32 | 48 | 25 | NC | 0.94 | NC | 0.28 | 0.26 | 0.17 | 0.38 |

# Table 4-28
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| 1,1-Dichloroethane | 0.19 | 44 | 25 | NC | 2.63 | NC | 0.70 | 0.88 | 0.34 | 1.06 |
| 1-Pentene | 0.25 | 44 | 25 | NC | 2.48 | NC | 0.24 | 0.47 | 0.05 | 0.44 |
| Acetone | 0.25 | 44 | 25 | NC | 66.1 | NC | 10.5 | 19.2 | 2.60 | 18.5 |
| Trichlorofluoromethane | 0.18 | 40 | 25 | NC | 1.87 | NC | 0.49 | 0.58 | 0.25 | 0.73 |
| 1,1,1-Trichloroethane | 0.18 | 36 | 25 | NC | 0.92 | NC | 0.21 | 0.20 | 0.13 | 0.30 |
| Cyclopentane | 0.25 | 36 | 25 | NC | 1.40 | NC | 0.36 | 0.43 | 0.18 | 0.54 |
| Freon 113 | 0.87 | 36 | 25 | NC | 0.30 | NC | 0.31 | 0.26 | 0.21 | 0.42 |
| t-2-Butene | 0.25 | 36 | 25 | NC | 0.47 | NC | 0.20 | 0.11 | 0.15 | 0.24 |
| Methylene Chloride | 0.31 | 36 | 25 | NC | 1.67 | NC | 0.42 | 0.45 | 0.24 | 0.61 |
| Chloroethane | 0.22 | 36 | 25 | NC | 0.75 | NC | 0.24 | 0.22 | 0.14 | 0.33 |
| 1,1,2,2-Tetrachloroethane | 0.32 | 32 | 25 | NC | 0.05 | NC | 0.11 | 0.09 | 0.07 | 0.15 |
| 2-Methylheptane | 0.25 | 32 | 25 | NC | 0.45 | NC | 0.16 | 0.13 | 0.11 | 0.22 |
| 1-Heptene | 0.25 | 32 | 25 | NC | 1.31 | NC | 0.20 | 0.24 | 0.10 | 0.30 |
| 1,1-Dichloroethylene | 3.15 | 28 | 25 | NC | 0.14 | NC | 1.09 | 0.93 | 0.71 | 1.47 |
| 2,4-Dimethylpentane | 0.25 | 28 | 25 | NC | 0.25 | NC | 0.12 | 0.07 | 0.08 | 0.15 |
| 3-Methyl-1-Butene | 0.25 | 28 | 25 | NC | 0.23 | NC | 0.12 | 0.07 | 0.09 | 0.15 |
| t-3-Heptene | 0.25 | 24 | 25 | NC | 0.47 | NC | 0.15 | 0.12 | 0.10 | 0.20 |
| 1-Decene | 0.25 | 20 | 25 | NC | 1.83 | NC | 0.25 | 0.36 | 0.10 | 0.40 |
| Ethanol & Acetonitrile | 0.25 | 20 | 25 | NC | 95.4 | NC | 9.36 | 25.8 | 0.00 | 20.0 |
| t-2-Heptene | 0.25 | 20 | 25 | NC | 1.43 | NC | 0.26 | 0.33 | 0.12 | 0.39 |
| t-2-Hexene | 0.25 | 20 | 25 | NC | 0.23 | NC | 0.14 | 0.07 | 0.11 | 0.17 |
| 2-Methyl-2-Pentene | 0.25 | 20 | 25 | NC | 0.15 | NC | 0.12 | 0.07 | 0.09 | 0.14 |
| 1-Butanol | 0.25 | 16 | 25 | NC | 0.52 | NC | 0.16 | 0.10 | 0.12 | 0.20 |
| Methylisobutylketone | 0.25 | 16 | 25 | NC | 0.17 | NC | 0.12 | 0.06 | 0.09 | 0.14 |
| Heptanal | 0.25 | 16 | 25 | NC | 1.61 | NC | 0.27 | 0.36 | 0.12 | 0.42 |

# Table 4-28
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) | | | | | 95% Confidence Intervals | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Median | Mean | Standard Deviation | Lower (ppm) | Upper (ppm) |
| Cyclopentene | 0.25 | 16 | 25 | NC | 0.25 | NC | 0.14 | 0.09 | 0.10 | 0.17 |
| 2,3-Dimethylbutane | 0.25 | 16 | 25 | NC | 17.8 | NC | 0.86 | 3.53 | 0.00 | 2.32 |
| 3-Methylpentane | 0.25 | 12 | 25 | NC | 0.11 | NC | 0.12 | 0.08 | 0.09 | 0.16 |
| c-1,3-Dichloropropene | 0.77 | 12 | 25 | NC | 0.07 | NC | 0.31 | 0.21 | 0.22 | 0.40 |
| c-2-Butene | 0.25 | 12 | 25 | NC | 0.20 | NC | 0.14 | 0.07 | 0.12 | 0.17 |
| c-2-Pentene | 0.25 | 12 | 25 | NC | 0.31 | NC | 0.14 | 0.07 | 0.11 | 0.16 |
| 1,2-Dichloroethane | 0.37 | 8 | 25 | NC | 0.05 | NC | 0.16 | 0.11 | 0.12 | 0.20 |
| c-3-Heptene | 0.25 | 8 | 25 | NC | 0.12 | NC | 0.13 | 0.06 | 0.10 | 0.15 |
| 1,2-Dichloropropane | 0.22 | 4 | 25 | NC | 0.08 | NC | 0.13 | 0.07 | 0.10 | 0.15 |
| p-Isopropyltoluene | 0.25 | 4 | 25 | NC | 1.47 | NC | 0.16 | 0.28 | 0.05 | 0.28 |
| c-3-Hexene | 0.25 | 4 | 25 | NC | 1.18 | NC | 0.17 | 0.22 | 0.08 | 0.26 |
| Methylcyclopentene | 0.25 | 4 | 25 | NC | 0.40 | NC | 0.13 | 0.10 | 0.09 | 0.17 |
| Methanol (+) | 0.25 | 4 | 25 | NC | 4.74 | NC | 0.31 | 0.93 | 0.00 | 0.69 |
| Bromodichloromethane | 0.25 | 4 | 25 | NC | 0.04 | NC | 0.14 | 0.07 | 0.11 | 0.16 |
| 3,5,5-Trimethylhexene | 0.25 | 4 | 25 | NC | 0.06 | NC | 0.16 | 0.07 | 0.13 | 0.19 |
| 1,4-Dioxane | 0.25 | 4 | 25 | NC | 0.13 | NC | 0.14 | 0.08 | 0.10 | 0.17 |
| 1,1,2-Trichloroethane | 0.27 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 2,4-4-Trimethyl-2-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 2-Ethyl-1-Butene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Bromomethane | 0.37 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Bromoform | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Bromochloromethane | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Benzaldehyde | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Acrylonitrile | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Acetaldehyde | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |

# Table 4-28
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4-Nonene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 4-Methyl-1-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| t-4-Methyl-2-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| t-1,3-Dichloropropene | 0.13 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| t-1,2-Dichloroethylene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| p-Chlorotoluene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| o-Chlorotoluene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| m-Chlorotoluene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| c-4-Methyl-2-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| c-3-Methyl-2-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Octene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| c-2-Hexene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Vinyl Bromide | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Vinyl Acetate | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Trichloroethylene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Neopentane | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Methyl t-Butylether | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Indene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Indan | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Freon 23 | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Ethylene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Diethyl Ether &2-Propanol | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Dibromochloromethane | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Cyclohexene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Chloroprene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |

# Table 4-28
# (Continued)

| Compound | Detection Limit (ppm) | Percent Detected (%) | No. Samples | Concentration (ppm) Minimum | Maximum | Median | Mean | Standard Deviation | 95% Confidence Intervals Lower (ppm) | Upper (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Chloroform | 0.19 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Chlorodifluoromethane | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Carbon Tetrachloride | 0.36 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| Butyraldehyde | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 2-Methyl-1-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 2-Butanone | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 2,4,4-Trimethyl-1-Pentene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 1-Propanol | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 1,2-Dibromoethane | 0.28 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 1-Nonene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |
| 1,3-Butadiene | 0.25 | 0 | 25 | NC | NC | NC | NC | NC | NC | NC |

ND = Not Detected
NC = Not Calculated

# Table 4-29
## Concentration and Emission Results for Select VOCs from Sampling of Gas Extraction Wells

| Site ID / Compound Name | BK-10 | | BK-17 | | BK-19 | | BK-24 | | BK-29 | | BK-31 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | ND | NC | ND | NC | ND | NC | ND | NC | 0.15 | 7.39 | ND | NC |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| 1,1-Dichloroethane | ND | NC | ND | NC | ND | NC | ND | NC | 0.06 | 4.46 | ND | NC |
| c-1,2-Dichloroethylene | 0.12 | 2.23 | 0.26 | 4.53 | 0.05 | 1.03 | 0.04 | 2.57 | 0.42 | 31.8 | 0.14 | 28.6 |
| 1,1,1-Trichloroethane | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC | ND | NC |
| Benzene | 0.16 | 2.36 | 0.46 | 6.33 | 0.68 | 12.3 | 0.86 | 47.2 | 0.83 | 51.2 | 1.14 | 184 |
| Toluene | 3.30 | 57.9 | 4.75 | 77.3 | 5.34 | 114 | 8.10 | 523 | 7.27 | 528 | 7.84 | 1490 |
| Chlorobenzene | 0.13 | 2.84 | 0.32 | 6.30 | 0.33 | 8.71 | 0.54 | 42.3 | 0.49 | 43.4 | 0.60 | 140 |
| Ethylbenzene | 1.00 | 20.2 | 1.66 | 31.3 | 1.64 | 40.3 | 2.95 | 220 | 2.56 | 214 | 4.17 | 915 |
| p-Xylene + m-Xylene | 1.00 | 20.2 | 1.65 | 31.0 | 2.38 | 58.5 | 3.26 | 243 | 2.64 | 221 | 3.69 | 810 |
| Styrene | 0.30 | 5.98 | 0.48 | 8.79 | 0.58 | 13.9 | 1.00 | 72.9 | 0.79 | 64.6 | 0.85 | 184 |
| 1,1,2,2-Tetrachloroethane | ND | NC | ND | NC | ND | NC | 0.01 | 1.71 | ND | NC | ND | NC |
| o-Xylene | 0.41 | 8.31 | 0.71 | 13.4 | 0.96 | 23.6 | 1.50 | 112 | 0.41 | 34.4 | 1.36 | 299 |
| n-Nonane | 0.50 | 12.3 | 0.93 | 21.1 | 1.28 | 37.9 | 2.67 | 240 | 1.57 | 159 | 2.14 | 569 |
| 1,2,4-Trichlorobenzene | 0.37 | 12.8 | 0.55 | 17.6 | 0.55 | 23.0 | 1.84 | 233 | 0.78 | 111 | 0.98 | 368 |
| Benzyl Chloride & m-Dichlorobenzene | 0.33 | 8.60 | 0.60 | 14.5 | 0.87 | 27.6 | 0.83 | 79.8 | 0.42 | 44.9 | 0.71 | 201 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 1.39 | 33.6 | 2.37 | 53.4 | 3.20 | 94 | 6.01 | 535 | 3.85 | 386 | 5.44 | 1430 |
| Trichloroethene | ND | NC | ND | NC | ND | NC | 0.03 | 2.89 | 0.06 | 6.71 | 0.02 | 5.98 |
| TNMHC | 148 | 2,420 | 222 | 3,380 | 265 | 5,280 | 592 | 35,700 | 314 | 21,300 | 355 | 63,100 |

# Table 4-29
# (Continued)

| Site ID<br>Compound Name | BK-37 | | BK-39 | | C-13 | | C-6 | | D-1 | | D-7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | ND | NC | 0.20 | 22.3 | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| Methylene Chloride | ND | NC | ND | NC | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| 1,1-Dichloroethane | 0.05 | 2.89 | ND | NC | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| c-1,2-Dichloroethylene | 0.16 | 9.59 | 0.09 | 14.9 | ND | NC | ND | NC[1] | ND | NC | 0.03 | 2.15 |
| 1,1,1-Trichloroethane | ND | NC | ND | NC | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| Benzene | 0.62 | 30.4 | 1.13 | 156 | 0.29 | 7.27 | 0.44 | NC[1] | 0.61 | 20.8 | 0.63 | 33.6 |
| Toluene | 9.87 | 569 | 9.27 | 1510 | 2.29 | 67.5 | 4.34 | NC[1] | 4.56 | 183 | 5.89 | 373 |
| Chlorobenzene | 0.72 | 50.7 | 0.58 | 116 | 0.19 | 6.88 | 0.31 | NC[1] | 0.22 | 10.7 | 0.34 | 26.2 |
| Ethylbenzene | 3.91 | 260 | 4.39 | 825 | 1.10 | 37.3 | 1.78 | NC[1] | 1.91 | 88.5 | 2.54 | 185 |
| p-Xylene + m-Xylene | 3.68 | 244 | 3.64 | 684 | 1.17 | 40.0 | 1.74 | NC[1] | 1.96 | 90.5 | 2.75 | 201 |
| Styrene | 1.07 | 69.9 | 0.90 | 165 | 0.23 | 7.51 | 0.41 | NC[1] | 0.49 | 22.2 | 0.51 | 36.2 |
| 1,1,2,2-Tetrachloroethane | ND | NC | ND | NC | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| o-Xylene | 1.72 | 114 | 1.34 | 251 | 0.42 | 14.4 | 0.66 | NC[1] | 0.70 | 32.2 | 1.03 | 75.2 |
| n-Nonane | 2.66 | 214 | 1.94 | 439 | 0.60 | 24.7 | 0.91 | NC[1] | 1.05 | 58.7 | 1.44 | 127 |
| 1,2,4-Trichlorobenzene | 0.82 | 93.0 | 1.10 | 352 | 0.26 | 15.2 | 0.66 | NC[1] | 0.53 | 41.7 | 0.69 | 85.4 |
| Benzyl Chloride & m-Dichlorobenzene | 0.67 | 57.0 | 1.34 | 323 | 0.38 | 16.5 | 0.78 | NC[1] | 0.70 | 41.7 | 1.01 | 94.5 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.50 | 358 | 4.38 | 985 | 1.24 | 50.5 | 2.75 | NC[1] | 2.23 | 124 | 3.06 | 267 |
| Trichloroethene | 0.06 | 5.31 | 0.03 | 6.11 | ND | NC | ND | NC[1] | ND | NC | ND | NC |
| TNMHC | 353.00 | 19,000 | 386 | 58,700 | 127 | 3,490 | 206 | NC[1] | 213 | 7,980 | 270 | 15,900 |

# Table 4-29
# (Continued)

| Site ID / Compound Name | F-2 | | F-4 | | F-5 | | H-7 | | J-1 | | J-14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 0.15 | 16.9 | ND | NC | ND | NC | ND | NC | 0.05 | 1.20 | 0.46 | 7.24 |
| 1,1-Dichloroethylene | ND | NC | ND | NC | ND | NC | ND | NC | 0.08 | 3.00 | 0.14 | 3.33 |
| Methylene Chloride | ND | NC | ND | NC | ND | NC | ND | NC | 0.93 | 29.4 | 0.36 | 7.70 |
| 1,1-Dichloroethane | ND | NC | ND | NC | ND | NC | ND | NC | 2.10 | 77.7 | 2.63 | 65.6 |
| c-1,2-Dichloroethylene | 0.08 | 14.1 | 0.05 | 1.96 | 0.06 | 3.12 | 0.34 | 18.5 | 1.83 | 66.5 | 1.32 | 32.3 |
| 1,1,1-Trichloroethane | ND | NC | ND | NC | ND | NC | ND | NC | 0.56 | 28.1 | 0.22 | 7.47 |
| Benzene | 1.22 | 173 | 0.99 | 31.5 | 1.35 | 58.2 | 4.06 | 179 | 0.67 | 19.6 | 1.25 | 24.5 |
| Toluene | 12.18 | 2040 | 8.57 | 322 | 8.55 | 434 | 29.44 | 1530 | 33.83 | 1170 | 41.12 | 953 |
| Chlorobenzene | 0.72 | 147 | 0.53 | 24.2 | 0.50 | 31.3 | 2.75 | 175 | 2.50 | 105 | 2.73 | 77.4 |
| Ethylbenzene | 4.39 | 848 | 3.01 | 131 | 4.02 | 235 | 10.11 | 606 | 6.63 | 263 | 7.30 | 195 |
| p-Xylene + m-Xylene | 6.30 | 1210 | 3.72 | 161 | 3.68 | 215 | 13.2 | 790 | 9.55 | 379 | 10.5 | 281 |
| Styrene | 1.32 | 249 | 0.82 | 34.9 | 0.90 | 51.7 | 2.89 | 170 | 6.15 | 240 | 5.59 | 146 |
| 1,1,2,2-Tetrachloroethane | 0.02 | 7.20 | ND | NC | 0.03 | 2.38 | 0.05 | 5.03 | 0.01 | 0.79 | 0.01 | 0.59 |
| o-Xylene | 2.37 | 457 | 1.44 | 62.2 | 1.40 | 81.7 | 4.97 | 298 | 3.53 | 140 | 3.29 | 87.9 |
| n-Nonane | 3.80 | 885 | 2.27 | 119 | 2.23 | 158 | 8.84 | 640 | 6.72 | 323 | 7.52 | 243 |
| 1,2,4-Trichlorobenzene | 0.99 | 326 | 0.63 | 46.4 | 0.99 | 98.9 | 1.56 | 160 | 0.34 | 23.0 | 0.35 | 16.0 |
| Benzyl Chloride & m-Dichlorobenzene | 0.75 | 186 | 1.08 | 60.2 | 1.59 | 120 | 4.91 | 380 | 1.84 | 93.9 | 2.60 | 89.5 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 5.93 | 1370 | 3.40 | 177 | 5.08 | 356 | 10.1 | 727 | 3.64 | 173 | 4.67 | 149 |
| Trichloroethene | 0.02 | 5.66 | ND | NC | ND | NC | 0.05 | 4.02 | 0.94 | 46.1 | 0.88 | 29.3 |
| TNMHC | 468 | 73,100 | 304 | 10,600 | 408 | 19,300 | 969 | 47,000 | 585 | 18,800 | 692 | 15,000 |

# Table 4-29
# (Continued)

| Site ID / Compound Name | J-17 | | J-28 | | J-3 | | J-4 | | J-6 | | J-7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| Vinyl Chloride | 0.32 | 8.34 | 0.23 | 14.8 | 0.67 | 19.1 | 0.81 | 49.4 | 0.17 | 11.3 | 0.94 | 77.2 |
| 1,1-Dichloroethylene | 0.06 | 2.59 | 0.05 | 5.27 | 0.04 | 1.76 | ND | NC | ND | NC | 0.06 | 7.06 |
| Methylene Chloride | 1.22 | 43.9 | 0.75 | 67.2 | 1.67 | 64.7 | 0.22 | 18.6 | 0.88 | 78.1 | 0.77 | 86.5 |
| 1,1-Dichloroethane | 1.48 | 61.6 | 1.11 | 116 | 2.08 | 93.8 | 1.41 | 136 | 1.18 | 122 | 1.36 | 177 |
| c-1,2-Dichloroethylene | 0.73 | 29.8 | 0.60 | 61.2 | 0.61 | 26.8 | 1.71 | 161 | 0.63 | 64.3 | 2.48 | 317 |
| 1,1,1-Trichloroethane | 0.53 | 29.7 | 0.41 | 58.0 | 0.33 | 20.3 | 0.28 | 36.1 | 0.25 | 34.5 | 0.23 | 41.2 |
| Benzene | 0.42 | 13.9 | 0.33 | 26.9 | 0.47 | 16.8 | 0.44 | 33.3 | 0.38 | 30.9 | 0.47 | 48.1 |
| Toluene | 29.14 | 1130 | 19.32 | 1880 | 24.75 | 1040 | 19.71 | 1770 | 20.96 | 2020 | 26.19 | 3180 |
| Chlorobenzene | 1.89 | 90.0 | 1.77 | 210 | 1.92 | 98.5 | 1.74 | 190 | 1.48 | 175 | 1.92 | 286 |
| Ethylbenzene | 5.66 | 253 | 3.41 | 382 | 3.60 | 174 | 3.41 | 353 | 3.99 | 444 | 4.40 | 617 |
| p-Xylene + m-Xylene | 9.22 | 413 | 5.08 | 569 | 5.96 | 289 | 6.12 | 632 | 6.55 | 728 | 7.22 | 1010 |
| Styrene | 3.90 | 171 | 3.34 | 367 | 3.69 | 175 | 3.72 | 376 | 3.04 | 332 | 3.18 | 437 |
| 1,1,2,2-Tetrachloroethane | ND | NC | ND | NC | 0.01 | 0.67 | ND | NC | ND | NC | ND | NC |
| o-Xylene | 1.02 | 45.7 | 4.52 | 506 | 3.44 | 166 | 2.02 | 209 | 1.97 | 219 | 2.22 | 312 |
| n-Nonane | 5.29 | 286 | 3.58 | 485 | 4.28 | 250 | 4.02 | 502 | 4.07 | 548 | 4.83 | 818 |
| 1,2,4-Trichlorobenzene | 0.12 | 9.37 | 0.09 | 17.5 | 0.18 | 14.8 | 0.12 | 20.6 | 0.22 | 41.7 | 0.15 | 36.1 |
| Benzyl Chloride & m-Dichlorobenzene | 1.36 | 78.5 | 1.25 | 181 | 0.36 | 22.1 | 0.32 | 43.1 | 1.22 | 175 | 1.15 | 208 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 2.97 | 159 | 2.81 | 377 | 2.42 | 140 | 2.03 | 252 | 2.73 | 363 | 2.30 | 385 |
| Trichloroethene | 0.51 | 28.1 | 0.46 | 63.7 | 0.48 | 28.5 | 0.68 | 86.5 | 0.49 | 67.1 | 0.75 | 131 |
| TNMHC | 371 | 13,400 | 459 | 41,600 | 363 | 14,200 | 358 | 29,900 | 421 | 37,900 | 384 | 43,500 |

# Table 4-29
# (Continued)

| Site ID<br>Compound Name | J-8 | |
|---|---|---|
| | (ppm) | (ug/sec) |
| Vinyl Chloride | 0.79 | 48.2 |
| 1,1-Dichloroethylene | 0.08 | 7.94 |
| Methylene Chloride | 1.24 | 103 |
| 1,1-Dichloroethane | 2.54 | 246 |
| c-1,2-Dichloroethylene | 1.41 | 133 |
| 1,1,1-Trichloroethane | 0.92 | 121 |
| Benzene | 0.92 | 70.3 |
| Toluene | 37.6 | 3400 |
| Chlorobenzene | 4.26 | 469 |
| Ethylbenzene | 5.24 | 545 |
| p-Xylene + m-Xylene | 8.78 | 914 |
| Styrene | 6.50 | 662 |
| 1,1,2,2-Tetrachloroethane | 0.01 | 2.40 |
| o-Xylene | 5.29 | 551 |
| n-Nonane | 6.63 | 834 |
| 1,2,4-Trichlorobenzene | 0.32 | 56.1 |
| Benzyl Chloride & m-Dichlorobenzene | 2.07 | 277 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.24 | 528 |
| Trichloroethene | 0.93 | 119 |
| TNMHC | 637 | 53,700 |

ND = Not Detected
NC = Not Calculated
NC[1] = Flow rate not available due to problems with flow orifice.

# Table 4-30
## Concentration and Emissions of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Gas Extraction Wells

| Gas Extraction Well # | Flow Rate ($m^3$/min) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | (ug/sec) | (ppm) | (ug/sec) |
| BK-10 | 0.28 | 15.2 | 1.27 | 20.0 | 0.610 | 13.2 | 0.805 | 42.00 | 272 | NM | NM |
| BK-17 | 0.26 | 16.7 | 1.30 | 20.5 | 0.580 | 12.9 | 0.730 | 74.30 | 448 | NM | NM |
| BK-19 | 0.34 | 36.9 | 3.76 | 46.0 | 1.70 | 3.5 | 0.259 | 54.00 | 425 | NM | NM |
| BK-24 | 1.03 | 17.6 | 5.43 | 24.0 | 2.69 | 12.2 | 2.74 | 3.40 | 81.0 | NM | NM |
| BK-29 | 1.16 | 13.0 | 4.51 | 16.9 | 2.13 | 14.9 | 3.76 | 11.00 | 296 | 0.20 | 31.7 |
| BK-31 | 3.04 | 26.0 | 23.7 | 38.0 | 12.6 | 7.0 | 4.63 | 45.00 | 3170 | 0.40 | 166 |
| BK-37 | 0.92 | 14.3 | 3.94 | 37.4 | 3.75 | 9.9 | 1.98 | 44.00 | 938 | NM | NM |
| BK-39 | 2.60 | 28.5 | 22.2 | 42.2 | 11.9 | 5.6 | 3.17 | 41.00 | 2470 | NM | NM |
| C-13 | 0.47 | 20.8 | 2.93 | 26.6 | 1.36 | 10.4 | 1.06 | 22.60 | 246 | 0.39 | 25.0 |
| C-6 | 0.0 | 39.2 | 0.0 | 50.6 | 0.0 | 1.3 | 0.0 | 73.00 | 0.0 | 0.87 | 0.0 |
| D-1 | 0.64 | 30.0 | 5.75 | 38.8 | 2.70 | 5.7 | 0.794 | 41.80 | 620 | 0.42 | 36.7 |
| D-7 | 1.01 | 27.8 | 8.40 | 38.2 | 4.20 | 6.1 | 1.34 | 39.40 | 922 | 0.75 | 103 |
| F-2 | 2.67 | 32.2 | 25.7 | 46.8 | 13.6 | 4.4 | 2.56 | 43.00 | 2660 | 0.43 | 157 |
| F-4 | 0.60 | 43.3 | 7.78 | 53.9 | 3.52 | 0.7 | 0.091 | 83.30 | 1160 | NM | NM |
| F-5 | 0.81 | 34.7 | 8.41 | 46.2 | 4.07 | 3.3 | 0.582 | 56.40 | 1060 | 1.08 | 119 |
| H-7 | 0.83 | 42.7 | 10.6 | 56.3 | 5.09 | 0.6 | 0.108 | 53.60 | 1030 | 0.48 | 54.4 |
| J-1 | 0.55 | 39.5 | 6.50 | 56.0 | 3.35 | 1.1 | 0.132 | 43.40 | 553 | 0.27 | 20.3 |
| J-14 | 0.37 | 27.0 | 2.99 | 40.5 | 1.63 | 6.6 | 0.532 | 51.90 | 445 | 0.38 | 19.2 |
| J-17 | 0.62 | 30.7 | 5.70 | 48.1 | 3.25 | 3.9 | 0.526 | 29.80 | 428 | 0.12 | 10.2 |
| J-28 | 1.55 | 26.6 | 12.3 | 43.7 | 7.37 | 6.6 | 2.23 | 26.00 | 934 | NM | NM |
| J-3 | 0.67 | 42.9 | 8.60 | 56.5 | 4.12 | 0.8 | 0.117 | 102.20 | 1590 | 0 | 0.0 |
| J-4 | 1.43 | 38.4 | 16.4 | 48.0 | 7.47 | 3.8 | 1.18 | 40.00 | 1330 | 0.75 | 146 |
| J-6 | 1.54 | 33.8 | 15.6 | 53.0 | 8.88 | 2.7 | 0.905 | 81.40 | 2910 | 0.27 | 56.7 |
| J-7 | 1.94 | 28.6 | 16.6 | 44.1 | 9.31 | 5.2 | 2.20 | 40.00 | 1800 | NM | NM |
| J-8 | 1.44 | 43.4 | 18.7 | 56.9 | 8.92 | 0.7 | 0.219 | 56.40 | 1880 | 0.26 | 51.1 |

NM = Not Measured

# Table 4-31
## Concentrations and Emissions of Select VOCs from Temporal Sampling of Gas Extraction Wells

| Date | Flow Rate ($m^3$/min) | Vinyl Chloride | | 1,1-Dichloroethylene | | Methylene Chloride | | 1,1-Dichloroethane | | c-1,2-Dichloroethylene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **BK-39** | | | | | | | | | | | |
| 07/10/95 | 2.60 | 0.20 | 22.3 | ND | NC | ND | NC | ND | NC | 0.09 | 14.9 |
| 07/11/95 | 1.14 | 0.30 | 14.4 | ND | NC | ND | NC | ND | NC | 0.09 | 6.58 |
| 07/12/95 | 2.17 | 0.28 | 26.0 | ND | NC | ND | NC | ND | NC | 0.18 | 25.9 |
| **F-2** | | | | | | | | | | | |
| 07/10/95 | 2.67 | 0.15 | 16.9 | ND | NC | ND | NC | ND | NC | 0.08 | 14.1 |
| 07/11/95 | 2.78 | 0.07 | 8.83 | ND | NC | ND | NC | ND | NC | 0.06 | 11.8 |
| 07/12/95 | 2.29 | ND | NC | ND | NC | ND | NC | ND | NC | 0.08 | 12.7 |
| **J-28** | | | | | | | | | | | |
| 07/10/95 | 1.55 | 0.23 | 14.8 | 0.05 | 5.27 | 0.75 | 67.2 | 1.11 | 116 | 0.60 | 61.2 |
| 07/11/95 | 1.31 | 0.30 | 16.4 | 0.08 | 6.67 | 1.07 | 80.9 | 1.26 | 111 | 0.69 | 59.3 |
| 07/12/95 | 1.48 | 0.36 | 22.8 | 0.08 | 7.79 | 1.16 | 99.2 | 1.45 | 145 | 0.87 | 84.8 |

# Table 4-31
# (Continued)

| Date | Flow Rate ($m^3$/min) | 1,1,1-Trichloroethane | | Benzene | | Toluene | | Chlorobenzene | | Ethylbenzene | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **BK-39** | | | | | | | | | | | |
| 07/10/95 | 2.60 | ND | NC | 1.13 | 156 | 9.27 | 1510 | 0.58 | 116 | 4.39 | 825 |
| 07/11/95 | 1.14 | ND | NC | 1.25 | 75.6 | 9.58 | 684 | 0.62 | 54.3 | 4.48 | 369 |
| 07/12/95 | 2.17 | ND | NC | 1.83 | 211 | 12.12 | 1650 | 0.79 | 131 | 5.69 | 892 |
| **F-2** | | | | | | | | | | | |
| 07/10/95 | 2.67 | ND | NC | 1.22 | 173 | 12.18 | 2040 | 0.72 | 147 | 4.39 | 848 |
| 07/11/95 | 2.78 | ND | NC | 1.05 | 155 | 11.08 | 1930 | 0.63 | 134 | 4.60 | 923 |
| 07/13/95 | 2.29 | ND | NC | 1.17 | 143 | 13.27 | 1900 | 0.84 | 148 | 5.14 | 851 |
| **J-28** | | | | | | | | | | | |
| 07/10/95 | 1.55 | 0.41 | 58.0 | 0.33 | 26.9 | 19.32 | 1880 | 1.77 | 210 | 3.41 | 382 |
| 07/11/95 | 1.31 | 0.42 | 50.1 | 0.47 | 32.8 | 23.66 | 1940 | 2.04 | 205 | 4.35 | 412 |
| 07/12/95 | 1.48 | 0.51 | 67.8 | 0.77 | 60.9 | 30.47 | 2830 | 3.19 | 371 | 5.25 | 562 |

# Table 4-31
# (Continued)

| Date | Flow Rate (acfm) | p-Xylene+m-Xylene | | Styrene | | 1,1,2,2-Tetrachloroethane | | o-Xylene | | n-Nonane | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) | (ppm) | (µg/sec) |
| **BK-39** | | | | | | | | | | | |
| 07/10/95 | 2.60 | 3.64 | 684 | 0.90 | 165 | ND | NC | 1.34 | 251 | 1.94 | 439 |
| 07/11/95 | 1.14 | 3.66 | 301 | 0.85 | 68.5 | 0.01 | 1.80 | 0.94 | 77 | 1.89 | 188 |
| 07/12/95 | 2.17 | 4.72 | 740 | 1.17 | 180 | 0.02 | 4.21 | 1.22 | 192 | 2.47 | 467 |
| **F-2** | | | | | | | | | | | |
| 7/10/95 | 2.67 | 6.30 | 1,210 | 1.32 | 248 | 0.02 | 7.20 | 2.37 | 457 | 3.80 | 885 |
| 7/11/95 | 2.78 | 5.61 | 1,120 | 1.09 | 215 | 0.02 | 6.70 | 1.97 | 395 | 3.38 | 819 |
| 7/13/95 | 2.29 | 7.12 | 1,180 | 1.39 | 225 | 0.03 | 7.85 | 2.54 | 420 | 4.21 | 842 |
| **J-28** | | | | | | | | | | | |
| 7/10/95 | 1.55 | 5.08 | 569 | 3.34 | 367 | ND | NC | 4.52 | 506 | 3.58 | 485 |
| 7/11/95 | 1.31 | 6.53 | 618 | 4.38 | 406 | ND | NC | 5.92 | 561 | 4.43 | 507 |
| 7/12/95 | 1.48 | 7.88 | 843 | 5.87 | 615 | ND | NC | 8.41 | 899 | 5.85 | 755 |

# Table 4-31
# (Continued)

| Date | Flow Rate (acfm) | 1,2,4-Trichlorobenzene (ppm) | 1,2,4-Trichlorobenzene ($\mu$g/sec) | Benzyl Chloride & m-Dichlorobenzene (ppm) | Benzyl Chloride & m-Dichlorobenzene ($\mu$g/sec) | Trichloroethene (ppm) | Trichloroethene ($\mu$g/sec) | 1,2,4-Trimethylbenzene & t-Butylbenzene (ppm) | 1,2,4-Trimethylbenzene & t-Butylbenzene ($\mu$g/sec) | TNMHC (ppm) | TNMHC ($\mu$g/sec) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BK-39** | | | | | | | | | | | |
| 07/10/95 | 2.60 | 1.10 | 352 | 1.34 | 323 | 0.03 | 6.11 | 4.38 | 985 | 386 | 58,700 |
| 07/11/95 | 1.14 | 1.20 | 169 | 1.13 | 120 | 0.03 | 2.86 | 4.34 | 428 | 367 | 24,500 |
| 07/12/95 | 2.17 | 1.37 | 366 | 0.73 | 147 | 0.04 | 7.95 | 5.84 | 1,100 | 503 | 63,900 |
| **F-2** | | | | | | | | | | | |
| 7/10/95 | 2.67 | 0.99 | 326 | 0.75 | 186 | 0.02 | 5.66 | 5.93 | 1,370 | 468 | 73,100 |
| 7/11/95 | 2.78 | 0.83 | 283 | 1.65 | 428 | ND | NC | 4.02 | 967 | 392 | 63,700 |
| 7/13/95 | 2.29 | 1.25 | 353 | 2.34 | 500 | 0.02 | 4.97 | 5.86 | 1,160 | 490 | 65,600 |
| **J-28** | | | | | | | | | | | |
| 7/10/95 | 1.55 | 0.09 | 17.5 | 1.25 | 181 | 0.46 | 63.7 | 2.81 | 377 | 459 | 41,600 |
| 7/11/95 | 1.31 | 0.22 | 36.0 | 0.78 | 94.7 | 0.55 | 64.3 | 3.63 | 411 | 614 | 47,000 |
| 7/12/95 | 1.48 | 0.20 | 37.0 | 2.20 | 303 | 0.67 | 89.1 | 3.50 | 448 | 626 | 54,200 |

ND = Not Detected
NC = Not Calculated

# Table 4-32
## Concentrations and Emissions of Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ from Temporal Sampling or Gas Extraction Wells

| Date | Flow Rate ($m^3$/min) | $CO_2$ | | $CH_4$ | | $O_2$ | | $H_2S$ | | Hg | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (g/sec) | (%) | (g/sec) | (%) | (g/sec) | (ppm) | ($\mu$g/sec) | (ppm) | ($\mu$g/sec) |
| **BK-39** | | | | | | | | | | | |
| 07/10/95 | 2.60 | 28.5 | 22.2 | 42.2 | 11.9 | 5.6 | 3.17 | 41.0 | 2470 | NM | NM |
| 07/11/95 | 1.14 | 29.9 | 10.2 | 48.8 | 6.06 | 3.8 | 0.94 | 48.0 | 1270 | 0.38 | 59.1 |
| 07/12/95 | 2.17 | 42.3 | 27.5 | 53.5 | 12.6 | 0.7 | 0.33 | 85.9 | 4320 | NM | NM |
| **F-2** | | | | | | | | | | | |
| 07/10/95 | 2.67 | 32.2 | 25.7 | 46.8 | 13.6 | 4.4 | 2.56 | 43.0 | 2660 | 0.43 | 157 |
| 07/11/95 | 2.78 | 36.4 | 30.3 | 49.1 | 14.9 | 3.2 | 1.94 | 39.2 | 2530 | 1.51 | 573 |
| 07/12/95 | 2.29 | 36.0 | 24.7 | 51.4 | 12.8 | 2.7 | 1.35 | NM | NM | NM | NM |
| **J-28** | | | | | | | | | | | |
| 07/10/95 | 1.55 | 26.6 | 12.3 | 43.7 | 7.37 | 6.6 | 2.23 | 26.0 | 934 | NM | NM |
| 07/11/95 | 1.31 | 37.3 | 14.6 | 58.8 | 8.38 | 1.4 | 0.40 | 40.0 | 1210 | 0.31 | 55.4 |
| 07/12/95 | 1.48 | 37.2 | 16.5 | 59.5 | 9.58 | 1.1 | 0.35 | 37.9 | 1300 | 0.66 | 133 |

NM = Not Measured

# Table 4-33
## Concentration of VOCs Detected in Condensate from Landfill Gas Collection System

| Compound | Concentration (µg/L) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | South[1] | | | | | North[2] | | | | Air/Water Separator[3] | | | |
| | 7/03/95 | 7/06/95 | 7/07/95 | 7/10/95 | 7/11/95 | 7/06/95 | 7/07/95 | 7/10/95 | 7/11/95 | 7/03/95 | 7/08/95 | 7/12/95 | 7/13/95 |
| Acetonitrile | ND | ND | ND | 788.00 | ND | 272.00 | 391.00 | 464.00 | 495.00 | ND | ND | 356.00 | 362.50 |
| Acetone | 8055.00 | 17250.00 | 14600.00 | 14000.00 | 17150.00 | 6040.00 | 6900.00 | 6075.00 | 7590.00 | 11750.00 | 9760.00 | 12450.00 | 9750.00 |
| Methylene Chloride | 35.55 | 76.35 | 50.00 | 166.00 | 46.70 | 82.80 | 82.25 | 106.90 | 23.50 | 41.20 | 174.00 | 32.40 | 31.45 |
| 2-Butanone | 12450.00 | 22650.00 | 20900.00 | 17000.00 | 21850.00 | 5235.00 | 5585.00 | 5025.00 | 5970.00 | 13200.00 | 9620.00 | 14750.00 | 11050.00 |
| c-1,2-Dichloroethylene | 6.27 | ND | ND | ND | ND | ND | ND | ND | ND | 4.43 | ND | ND | ND |
| 1,1,1-Trichloroethane | ND | ND | ND | ND | ND | 14.10 | 15.60 | ND | ND | ND | ND | ND | ND |
| Benzene | 5.65 | ND | ND | ND | ND | ND | ND | ND | ND | 3.68 | ND | ND | ND |
| Methylisobutylketone | 267.00 | 318.50 | 267.00 | 282.00 | 333.00 | 171.50 | 172.00 | 162.50 | 173.50 | 287.50 | 205.00 | 239.50 | 227.50 |
| Toluene | 107.50 | 73.70 | 86.00 | 64.90 | 69.70 | 47.00 | 47.10 | 52.10 | 40.50 | 57.80 | 81.60 | 61.60 | 56.30 |
| Tetrachloroethylene | 1.94 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Ethylbenzene | 34.00 | ND | ND | ND | ND | ND | ND | 13.20 | ND | 18.20 | ND | ND | ND |
| p-Xylene+m-Xylene | 54.20 | ND | 85.70 | ND | 25.90 | ND | 20.30 | 29.20 | 19.00 | 26.90 | 46.90 | 12.15 | 11.25 |
| Styrene | 8.77 | ND | ND | ND | ND | ND | ND | ND | ND | 5.12 | ND | ND | ND |
| o-Xylene | 25.30 | ND | ND | ND | ND | ND | ND | ND | ND | 14.40 | ND | ND | ND |
| Dibromomethane | 29.04 | 61.15 | 58.70 | 60.60 | 70.05 | 45.10 | 41.75 | 40.30 | 27.45 | 28.93 | 51.50 | 38.55 | 42.95 |
| 2-Hexanone | 47.30 | ND | ND | ND | ND | ND | ND | ND | ND | 37.60 | ND | ND | ND |

ND = Not Detected
[1]Sample collected from south field header.
[2]Sample collected from north field header.
[3]Sample collected from air/water separator located immediately downstream of north and south field header sampling locations.

## Table 4-34
## Mass Flow Rate of VOCs Detected in Condensate from Landfill Gas Collection System

| Compound Name | Condensate Production Rate (L/day) | Average Concentration (ug/L)[a] | Mass Flow Rate (g/sec) |
|---|---|---|---|
| Acetonitrile | 49,000 | 180 | 1.02e-04 |
| Acetone | 49,000 | 10,900 | 6.22e-03 |
| Methylene Chloride | 49,000 | 69.8 | 3.97e-05 |
| 2-Butanone | 49,000 | 12,200 | 6.92e-03 |
| c-1,2-Dichloroethylene | 49,000 | 0.55 | 3.15e-07 |
| Benzene | 49,000 | 0.46 | 2.62e-07 |
| Methylisobutylketone | 49,000 | 240 | 1.37e-04 |
| Toluene | 49,000 | 64.3 | 3.66e-05 |
| Ethylbenzene | 49,000 | 2.28 | 1.30e-06 |
| p-Xylene + m-Xylene | 49,000 | 20.9 | 1.19e-05 |
| Styrene | 49,000 | 0.64 | 3.64e-07 |
| o-Xylene | 49,000 | 1.80 | 1.03e-06 |
| Dibromomethane | 49,000 | 40.5 | 2.31e-05 |
| 2-Hexanone | 49,000 | 4.70 | 2.68e-06 |

[a]Based on samples collected from air/water separator on July 3, 8, 12, and 13.

# Table 4-35
## Concentrations of Select VOCs from Landfill Gas Monitoring Wells

| Compound Name | Concentration (ppm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 Deep | 10 Medium | 10 Shallow | 22 Deep | 22 Medium | 22 Shallow | 23 Deep | 23 Medium | 23 Shallow |
| Vinyl Chloride | ND | ND | ND | 0.57 | 0.04 | 1.82 | 0.72 | 0.10 | ND |
| 1,1-Dichloroethylene | ND | ND | ND | 0.02 | ND | 0.06 | ND | 0.18 | ND |
| Methylene Chloride | ND | ND | ND | ND | ND | ND | 0.31 | 0.26 | ND |
| 1,1-Dichloroethane | 0.08 | ND | ND | 0.43 | ND | 1.17 | 0.06 | 0.04 | ND |
| c-1,2-Dichloroethylene | 0.27 | ND | ND | 1.17 | 1.60 | 2.00 | 1.45 | 0.76 | ND |
| 1,1,1-Trichloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Benzene | 1.98 | 0.09 | 0.22 | 0.66 | 1.89 | 0.69 | 1.71 | 0.91 | ND |
| Toluene | 33.6 | 3.18 | 3.70 | 27.4 | 46.1 | 47.8 | 41.2 | 44.9 | 0.22 |
| Chlorobenzene | 2.78 | 0.26 | 0.40 | 2.31 | 3.56 | 4.14 | 3.34 | 4.71 | ND |
| Ethylbenzene | 8.06 | 1.33 | 2.76 | 8.21 | 10.4 | 12.6 | 12.2 | 12.0 | 0.18 |
| p-Xylene+m-Xylene | 11.7 | 2.42 | 4.98 | 10.7 | 12.6 | 15.8 | 19.2 | 17.3 | 0.25 |
| Styrene | 3.77 | 0.80 | 0.75 | 4.41 | 6.05 | 5.88 | 6.99 | 7.74 | ND |
| o-Xylene | 4.22 | 0.73 | 1.15 | 4.54 | 4.55 | 5.95 | 7.79 | 18.8 | 0.09 |
| n-Nonane | 6.93 | 1.04 | 1.46 | 9.32 | 10.2 | 13.2 | 10.3 | 13.2 | 0.05 |
| N-Undecane | 13.6 | 16.0 | 10.2 | 75.7 | 7.25 | 4.58 | 10.1 | 4.03 | 0.44 |
| Benzyl Chloride & m-Dichlorobenzene | 4.10 | 0.92 | 0.86 | 7.03 | 4.34 | 3.34 | 5.77 | 3.95 | ND |
| n-Decane & p-Dichlorobenzene | 23.0 | 8.29 | 8.06 | 76.2 | 25.9 | 19.5 | 34.6 | 20.9 | 0.42 |
| Trichloroethene | 0.07 | ND | ND | 0.14 | 0.25 | 0.19 | 0.07 | 0.55 | ND |
| 1,2,4 Trimethylbenzene & t-Butylbenzene | 6.22 | 2.21 | 4.49 | 9.32 | 7.05 | 6.40 | 9.95 | 6.74 | 0.14 |
| TNMHC | 895 | 226 | 302 | 1,210 | 1,070 | 663 | 1,050 | 989 | 23.0 |

ND = Not Detected

## Table 4-36
## Hg, $H_2S$, $CH_4$, $CO_2$, and $O_2$ Concentrations from Landfill Gas Monitoring Wells

| Monitoring Well # | $CO_2$ (%) | $CH_4$ (%) | $O_2$ (%) | $H_2S$ (ppm) | Hg (ppm) |
|---|---|---|---|---|---|
| 10 deep | 14.2 | 20.1 | 13.9 | 82.1 | NM |
| 10 medium | 0.1 | 0.2 | 20.7 | 24.1 | NM |
| 10 shallow | 10.0 | 18.0 | 15.3 | 214.3 | NM |
| 22 deep | 0.6 | 1.2 | 20.2 | 11.3 | NM |
| 22 medium | 7.2 | 10.8 | 17.3 | 55.4 | NM |
| 22 shallow | 17.4 | 26.1 | 11.3 | 44.1 | NM |
| 23 deep | 23.1 | 33.3 | 9.2 | 116.1 | 0.93 |
| 23 medium | 8.7 | 15.2 | 16.5 | 270.9 | 1.24 |
| 23 shallow | 0.1 | 0.2 | 20.6 | 2.8 | 0.11 |

NM = Not Measured

# Table 4-37
## Summary of Activity Factor Information

| Feature | Parameter | Units | Landfill Section | | | |
|---|---|---|---|---|---|---|
| | | | 1/9 | 6/7 | 3/4 | 2/8 |
| Passive Vents | Total count | # | 36 | 0 | 119 | 102 |
| Entire Section | Surface area | hectare | 175.57 | 75.44 | 57.17 | 58.05 |
| Entire Section | Mass of Waste | $m^3$ | $3.70 \times 10^{10}$ | $1.15 \times 10^{10}$ | $1.21 \times 10^{10}$ | $1.05 \times 10^{10}$ |
| "Top" of Section | Surface area | hectare | 68.95 | 39.52 | 13.02 | 11.77 |
| | Mass Volume[c] | $m^3$ | $2.12 \times 10^{10}$ | $7.54 \times 10^{9}$ | $4.98 \times 10^{9}$ | $4.31 \times 10^{9}$ |
| "Side" of Section | Surface area | hectare | 56.24 | 20.31 | 22.10 | 21.70 |
| | Mass of Waste | $m^3$ | $8.16 \times 10^{9}$ | $2.70 \times 10^{9}$ | $4.92 \times 10^{9}$ | $4.23 \times 10^{9}$ |
| "Toe" of Section | Surface area | hectare | 30.02 | 13.33 | 22.05 | 24.58 |
| | Mass of Waste | $m^3$ | $1.70 \times 10^{9}$ | $1.27 \times 10^{9}$ | $2.16 \times 10^{9}$ | $1.97 \times 10^{9}$ |
| Active Face | Surface area | hectare | 1.07 | 2.28 | 0.0 | 0.0 |
| | Mass of Waste | $m^3$ | NA | NA | 0.0 | 0.0 |
| Landfill Gas Collection System | Surface Area | hectare | 19.29 | 0.0 | 0.0 | 0.0 |
| | Mass of Waste | $m^3$ | $7.82 \times 10^{9}$ | 0.0 | 0.0 | 0.0 |
| Cracks[a] | Surface area | $m^2$ | 1,756 | 754.4 | 571.7 | 580.5 |
| Seeps (wet) | Surface area | $m^2$ | 55.74 | 37.16 | 9.29 | 4.64 |
| Seeps (wet + dried)[b] | Surface area | $m^2$ | 55.74 | 37.16 | 9.29 | 4.64 |
| Perimeter Vent Trench[d] | Surface area | $m^2$ | 2,546 | 790 | 2,231 | 1,004 |
| Perimeter pipes | Total | # | 0 | 0 | 0 | 0 |

[a] Cracks were estimated to cover approximately 0.1% of entire surface area.
[b] Only wet seep areas were identified. Therefore, wet + dried seep area is set equal to wet seep area.
[c] Top of Section mass includes mass of active face which is located on the top of Section 1/9 and 6/7. Were unable to accurately measure mass of active face.
[d] Assumed width of vent trenches was 1.5 m (5 ft). Note: Vent trenches were not found during field investigation, but were found on autocad maps of each section.
NA = Not Available

## Table 4-38
## Summary of Activity Factors by Feature and Cover Material

| Feature | Surface Area (hectares)[a] | | | Total # Passive Vents | # Flowing Passive Vents |
|---|---|---|---|---|---|
| | Clay Cap | PVC Liner | Soil Cover | | |
| **Section 3/4** | | | | | |
| Toe | 8.55 | 0.80 | 12.69 | 33 | 11 |
| Side | 0.57 | 7.36 | 14.17 | 69 | 51 |
| Top | 0.0 | 0.10 | 12.93 | 17 | 17 |
| **Section 2/8** | | | | | |
| Toe | 6.05 | 0.76 | 17.77 | 16 | 4 |
| Side | 2.26 | 3.80 | 15.64 | 56 | 46 |
| Top | 0.0 | 2.70 | 9.07 | 30 | 30 |
| **Section 6/7** | | | | | |
| Toe | 0.0 | 0.0 | 13.33 | 0 | 0 |
| Side | 0.0 | 0.0 | 20.31 | 0 | 0 |
| Top | 0.0 | 0.0 | 39.52 | 0 | 0 |
| Active Face | 0.0 | 0.0 | 2.28 | 0 | 0 |
| **Section 1/9** | | | | | |
| Toe | 9.12 | 0.0 | 20.90 | 0 | 0 |
| Side | 10.50 | 0.0 | 45.74 | 28 | 8 |
| Top | 0.0 | 0.0 | 68.95 | 8 | 7 |
| LFG Collection System | 0.0 | 0.0 | 19.29 | 0 | 0 |
| Active Face | 0.0 | 0.0 | 1.07 | 0 | 0 |

[a] 1 hectare = 10,000 $m^2$ = 2.47 acres.

## 5.0 DISCUSSION OF RESULTS

In this section, the results presented in the previous section are further reduced and discussed. The measured emission rates, emission fluxes, and mass flow rates are summarized by section and by feature. The variability in the measurement data are evaluated. An overall emission rate for selected compounds is given for each section and for the entire landfill. The average composition of the landfill gas also is given. The results are compared with other published studies and information is provided for predicting future emissions.

### 5.1 Measurement Results for the Passive Vents

The VOC analyses of samples collected from the passive vents generally resulted in about 60 compounds being identified in each sample (results are given in Appendix D). These compounds included primarily alkanes (e.g., butane), aromatic compounds (e.g., toluene, xylenes), and chlorinated hydrocarbons (e.g., chlorobenzene). There was relatively little variation in the number and types of compounds detected from sample to sample.

The emission rate measurements for individual vents were averaged to develop an emission factor in units of g/sec per vent or μg/sec per vent. Emission factors were developed based on vent location on the landfill mound (top, side, and toe) and by type of cover surrounding the vent (soil, clay, and PVC). These emission factors were multiplied by the total number of vents with measurable flow (i.e., the activity factor) to yield the emission rate for that species. Total emission rates for selected species are given in Tables 5-1, 5-2, and 5-3 for Sections 1/9, 2/8, and 3/4, respectively. (All tables appear at the end of the section following the text and figures). Complete data for all compounds are given in Appendix M.

The emission rate data follow certain trends. In general, the emission rate per vent is highest from the top of a section and lowest from the toe of a section. This is consistent with the fact that a larger volume and mass of waste is present under the top areas than is present than under the toe areas. It implies that the landfill gas more readily migrates upward than laterally. Some of the passive vents at the toe areas actually were found to have negative flow; i.e., ambient air was being drawn into the vents due to the vacuum produced by gas flow elsewhere in the landfill. The emission rate per vent from the sides of the landfill is intermediate between the rates from the top and toe areas.

The type of cover material surrounding the vent has some effect on emissions from the vent. At locations covered by a synthetic cover, the emission rate from the passive vents was relatively large. This implies that the cover serves to limit gas transport through the surface and the gas preferentially exits the landfill via the passive vents. The clay cover was present primarily on the toes and sides of the landfill sections. There was little difference in emissions for vents in areas with soil versus those in areas with clay cover. This is somewhat unexpected and implies that the clay cap fails to retard gas transport. This is probably due to erosion of the clay cap, which produces pathways for gas transport.

The emission rates for selected species were summed to develop total emission rate values by section and for the entire landfill. The total emission rates for passive vents are given in Table 5-4. Complete data for all compounds are given in Appendix M. TNMHC emissions from all passive vents are about 3.9 g/sec; emissions of individual VOCs are 0.2 g/sec or less. The total emission rates of methane and carbon dioxide are 900-1,800 g/sec and hydrogen sulfide emissions were about 0.15 g/sec. Hydrogen sulfide has a very low odor threshold and the emissions of this compound from the passive vents certainly contributes to the characteristic odor of the landfill. Mercury emissions were 0.00545 g/sec from the passive vents.

The measurement program included tests to determine the section, spatial, temporal, sampling, and analytical variability of the data set. The variability for each of these factors (the variance component) was calculated using the SAS procedure PROC NESTED. The variability in the passive vent data is shown in Table 5-5 in terms of percent coefficient of variation (%CV). The sampling and analytical variabilities generally are small and are better than expected. The temporal variability is the variability introduced by the time of sampling; i.e., what is the effect of taking a sample at one time during the 3-week sampling effort as opposed to another time within that same 3-week period. The combination of sampling plus analytical plus temporal variability is the measurement variability. In most cases, this is less than +/- 50%. Again, this small amount of variability is better than expected.

Spatial variability is the variability from one vent to another within a given section. In most cases, the spatial variability is larger than the measurement variability. Section variability is the variability from one section of the landfill to another section. This variability tends to be smaller than the spatial variability, indicating that there is less difference from one section to another than there is for the vents within a given section. The total variability generally is less than 100% CV, indicating that for any measurement the overall variability is less than a factor of two. The variability for a representative compound -- toluene -- is depicted in Figure 5-1 (all figures appear at the end of the section following the text).

## 5.2 Measurement Results for the Surface Flux

During the course of this project, a total of 74 surface emission flux measurements were made. Flux chamber measurements were performed at different areas within each landfill section (i.e., top, side, toe, cracks, and seeps) and over various types of surface covers (i.e., soil, clay, and PVC cover). Measurements also were made over freshly deposited MSW (active face of Sections 1/9 and 6/7) and over areas that were affected by the vacuum of the gas collection system (Section 1/9).

The complete results for the VOC analysis of samples collected from the flux chambers are given in Appendix D. There were 50 compounds that were present in 50% of the flux chamber samples (See Table 4-14). These compounds included alkanes (e.g., isobutane), aromatics (e.g., toluene, benzene, xylenes), and chlorinated hydrocarbons (e.g., vinyl chloride, 1,1-dichloroethane). There was little variation in the types of compounds detected from sample to sample, but a large variation in the concentrations of compounds from sample to sample. The large variation in measured concentrations is a result of the large spatial variability in emissions at the landfill.

To extrapolate the flux chamber measurements to the entire landfill surface area (9.62 $m^2$ sampled compared to a landfill surface area of 3.66 x $10^6$ $m^2$), the flux chamber measurements were grouped according to the feature/cover/presence of landfill gas collection (LFG) system combinations presented in Table 5-6. The combinations presented in Table 5-6 are the prominent combinations present within each landfill section. However, due to the limited number of samples collected on Section 1/9, 3/4, and 2/8, some combinations were not sampled:

- Side/clay combination for Sections 2/8 and 3/4;
- Toe/clay/No LFG Collection System combination for Section 1/9;
- Toe/soil/No LFG Collection System combination for Section 1/9;
- Top/PVC combination for Sections 2/8 and 3/4;
- Active face for Section 1/9; and
- Cracks and Seeps for Section 2/8.

For the first five combinations listed above, the average flux for the existing data that most closely matched the combination was used. For example, the average flux measurements from the toe/clay combination at Section 2/8 was used for the side/clay combination at Section 2/8. Because no flux chamber measurements were made of the active face on Section 1/9, the average flux from the top/no gas extraction well combination was used; this is a valid estimate since the active face was actually atop the older waste. Unlike Sections 3/4, 6/7, and 1/9, there were no prominent cracks and seeps on Section 2/8. Therefore, no emission flux measurements were performed over seeps and cracks on Section 2/8.

After the flux chamber measurements were grouped according to the combinations presented in Table 5-6, the average compound emission fluxes for each combination was calculated. The average compound emission flux ($\mu g/m^2$-min) for each combination was then multiplied by the corresponding activity factor for the combination (surface area). The activity factors were presented in Tables 4-37 and 4-38.

The emission rates for selected VOCs are given in Tables 5-7 through 5-10 for Sections 1/9, 2/8, 3/4, and 6/7, respectively. Emission rates for all of the compounds measured are given in Appendix N. The distribution of the data was determined using the Shapiro-Wilks W-test. Bounds were calculated for the normally distributed data using the 95% confidence limits and for the non-normally distributed data using maximum and minimum values.

The landfill surface emission rates for select VOCs were summed to develop total emission rate values by section and for the entire landfill. The total surface emission rates are given in Table 5-11. The emission rate of TNMHC was 29.5 g/sec, hydrogen sulfide emissions were 0.301 g/sec, and all other compounds were emitted at rates of about 1.0 g/sec or less.

### 5.2.1 Surface Emissions over Soil, Clay and PVC Cover

Landfill sections 2/8 and 3/4 are the only sections that have PVC cover. Emissions for all compounds were significantly lower from areas with PVC cover as compared with emissions from areas with soil cover. The methane emission fluxes for PVC-covered areas are based on the lower detection limit for methane, because no methane was detected in the flux chamber samples. A better indication of emissions through the PVC cover are the TNMHC emissions, which averaged 3.09 and 5.74 ug/m$^2$-min, for Section 2/8 and 3/4, respectively, while TNMHC emissions for soil covered areas averaged 419 ug/m$^2$-min. However, the TNMHC emissions also are likely to be an overestimate of landfill emissions through the PVC cover, because it is probable that VOCs off-gassing from the PVC cover contributed to the measured emissions. In addition, the TNMHC concentrations from flux chamber samples taken over the PVC cover were near the detection limit of the analytical system, so more variability would be expected. Soil samples collected over the PVC cover showed no significant concentrations of VOCs, so it appears that VOCs off-gassing from the soil are not contributing to the measured TNMHC emissions at locations with the PVC cover.

Landfill Section 2/8, 3/4, and 1/9 all have a clay cover on a portion of each section. Emissions for all compounds were lower from areas with an intact clay cover as compared to emissions over soil covered areas. For example, TNMHC emissions over intact clay covered area on Section 2/8 averaged 3.53 as compared to TNMHC emissions over soil covered areas of 419 ug/m$^2$-min. The TNMHC emission over the clay cover on Section 3/4 was 3,340 ug/m$^2$-min, however, this emission flux measurement was obtained in an erosion channel through the clay cover. These data indicate that the clay cover is indeed suppressing emissions, and that it must be maintained to be effective.

### 5.2.2 Surface Emissions from Toe, Side, and Top

The majority of flux chamber measurements were made on Section 6/7, so the data from this section provides the best estimate of spatial variability in emissions. The emissions flux data from Section 6/7 indicate that flux rates are highest at the top of a section and lowest at the toe of the section, which is consistent with the fact that there is more waste under the top than the toe. In addition, this implies that the landfill gas tends to migrate upwards rather than laterally. The flux data from Section 6/7 also indicates that methane fluxes over the active face are not significantly different from those from the rest of the landfill. This is a result of the fact that the active face is actually on top of older MSW, therefore, emissions from the active face are the combined emissions of the new and old MSW.

### 5.2.3 Cracks and Seeps

Cracks were identified on all landfill sections, however, cracks on Sections 6/7 and Section 3/4 were more common and larger compared to cracks on the other landfill sections. The cracks on Section 6/7 were in an area covered by standing water, while the cracks on Section 3/4 were actually a five foot wide by three foot deep erosion channel through the clay cover. The measured TNMHC emissions from cracks averaged 566,000 and 3,340 ug/m$^2$-min for Section 6/7 and 3/4, respectively, as compared to TNMHC emissions through undisturbed soil of 419 ug/m$^2$-min. The elevated landfill gas flow rate from the cracks on Section 6/7 is likely a result of increased landfill gas generation due to the increased moisture content of the waste directly below the cracks and lateral movement of gas to the cracks. Although cracks were estimated to cover only 0.1% of the total landfill surface area, the TNMHC emissions through the cracks accounts for 24.2% of the total landfill surface emissions of TNMHC.

There are areas where liquid from within the landfill seeps out onto the landfill surface. The total surface area of soil wetted by seeped leachate is estimated to be 107 $m^2$, based on field observations. Seeps were identified on all landfill sections, but were prominent only at Sections 3/4, 6/7 and 1/9. All of the seeps occurred on either the toe or the bottom portion of the sides of the landfill. An attempt was made to identify areas where seeps had occurred and the landfill surface was now dry, but no such areas were identified. The analysis of liquid samples from the seeps showed only a handful of compounds and those few were at the low ppb level with the exception of one sample which had low ppm levels of 2-butanone (methyl ethyl ketone [MEK]).

TNMHC emissions from seeps averaged 18.0 $\mu g/m^2$-min, for Section 3/4, 13.5 $\mu g/m^2$-min, for Section 1/9, and 16,400 $ug/m^2$-min for Section 6/7, compared with average TNMHC emissions through soil of 419 $ug/m^2$-min. However, TNMHC emissions from seeps are less than 0.04% of the total TNMHC emissions from the landfill.

### 5.2.4 Spatial and Temporal Variations in Surface Emissions

Sources of variability for the surface emission fluxes include analytical, sampling, temporal, and spatial variability. Analytical variability was determined from replicate analysis of samples, while sampling variability was determined from collection of duplicate samples. Short-term temporal variability was determined from multiple emission flux measurements over time at four sampling locations on Section 6/7. The magnitude of each source of variability is expressed as %CV and are presented in Table 5-12. Both the spatial and temporal %CV are large with respect to the sampling and analytical %CV's. Surface emission fluxes vary with time primarily due to changes in environmental conditions within the landfill (i.e., temperature and moisture content) and in the surrounding environment (i.e., temperature, rainfall, and atmospheric pressure). For example, as the atmospheric pressure increases, the surface fluxes decrease. Also, rain will suppress surface fluxes as the water acts as a barrier to gas transport. Over longer periods of time, surface emission fluxes will decrease due to the decrease in degradable material available to the anaerobic bacteria. The temporal variability in TNMHC emissions measured at the four points on Section 6/7 are presented in Figure 5-2.

The spatial variability in surface fluxes are generally much larger than temporal variability, suggesting that surface fluxes are more a function of position than time. The spatial distribution of TNMHC emission flux from Section 6/7 are shown in Figure 5-3. The contour plot presented in Figure 5-3 was developed using Radian's Contour Plotting System (CPS). Due to the limited number of samples used to develop this contour plot, the plot should only be used to evaluate spatial variations in emissions and not the magnitude of emissions.

## 5.3 Measurement Results for the Gas Collection System

The gas collection system is comprised of over 200 vertical extraction wells, several lateral extraction wells, and two gas collection headers. The wells attach to the gas collection headers which route the landfill gas to the gas processing plant. A subset of the flowing gas extraction wells were sampled to assess spatial variability in mass flow rates while the gas collection header was sampled over several days to determine the average landfill gas composition and temporal variability in mass flow rates. The landfill gas collection system culminates in two major headers. These two headers represent the two major well fields in section 1/9, with each header collecting gas from over 100 extraction wells. The headers were sampled nine times during the program with the exception of VOC samples, which were collected six times.

The results of the individual flow rate and concentration measurements and the mass flow rates calculated from these values were given in Section 4. The total mass flow rate of gases to the plant are shown in Table 5-13. There were over 70 individual VOC compounds detected and quantified in the landfill gas header samples. The concentrations of the VOCs was quite constant over the duration of the program with %CVs generally in the single digits.

The consistency in measured concentrations is illustrated in Figure 5-4. The measured flow rate versus time is shown in Figure 5-5. The South Field Header typically had slightly higher concentrations than the North Header. This may have been due to the newest wells (the "J" series) being in the south field where recently accepted MSW is producing gas at a relatively rapid rate. Mass flow rates for the individual compounds were typically $10^{-1}$ to $10^{-3}$ g/sec per header with TNMHC emissions averaging 8 g/sec for the combined headers. This equates to a mass flow rate of about 700 kg/day of total VOCs. These VOCs are not being emitted to the environment, but they are an indication of the landfill's potential to produce VOCs.

The landfill gas and condensate entering the gas collection plant are processed and methane is recovered. The gas-phase VOCs and condensate are sent to an on-site incinerator for destruction, which acts to control air emissions of these compounds. Emissions from the plant were outside the scope of this study, but incineration typically achieves destruction efficiencies of 98% or higher (Eklund, et al., 1992).

The gas collection system functions by inducing a vacuum within the landfill mound and drawing vapors to the individual gas extraction wells. Contaminants within the landfill exist in equilibrium among gas-, liquid-, and solid-phases. Most VOCs are present in the gas-phase along with some fraction that is dissolved in either free liquid or the liquid film coating soil particles. Elemental mercury is predominantly a liquid at ambient temperatures, but it has some vapor pressure and is considered to be a semi-volatile material. Ogano-mercury compounds may be more volatile (and more toxic) than elemental mercury. The induced vacuum in the landfill will shift the equilibrium among the phases towards the gas phase. This effect should be small for the VOCs, which already are present primarily as vapors, but the vacuum should significantly increase the fraction of mercury that is present in the gas-phase. The magnitude of this effect will depend on the species of mercury that are present. The result is that the mass flow of mercury to the gas collection system is higher per unit mass of MSW than the emission rate of mercury from an equal mass of MSW that is not under vacuum.

The flow rate and concentrations of the major constituents of the landfill gas (i.e., methane and carbon dioxide) were quite consistent during the program. The flow rate data has a percent coefficient of variation (%CV) of about 8% for both headers, indicating relatively little variation in flow rate during the program. The %CVs for the $CH_4$ concentration ranged from 44% to 60% and averaged 56%. The %CVs for the $CO_2$ concentration ranged from 29% to 40% and averaged 37%. The differences between the two headers were very slight. $H_2S$ concentrations were approximately 20% higher in the South Field Header than the North Field Header. The mercury concentrations ranged from 0.2 ppm to 1.2 ppm. The CVs for mercury were near 50% for both headers. Oxygen concentrations averaged 1%, which is very near the instrument detection limit. The variability in concentration was quite high for oxygen, which is expected given the many non detects in the data set and the many measurements that were near the detection limit.

The mass flow rates measured at the headers also showed good precision. Carbon dioxide mass flow rates averaged 1,180 g/sec in the North Header and 2,110 g/sec in the South Header. The methane mass flow rates averaged 650 g/sec in the North Header and 1,290 g/sec in the South Header. The differences in mass flow between the two headers is primarily a function of the gas plant flow rate which changes depending on plant conditions and capacity. The measurements made using the pitot tubes installed in the two headers showed values approximately twice as high as the values reported by the Air Products gas plant. The values measured at the headers and the values reported by the gas plant are shown in Table 5-14. The flow rate measurements were made using standard pitot tubes installed by Air Products several years ago. At the start of the program the pitots were plugged so they were cleared with high pressure helium prior to use. This appeared to result in reasonable and reproducible values. We did not, however, remove and inspect the pitot tubes for physical damage. Several assumptions were used to calculate mass flow through the headers that were not empirically measured. The cross-sectional area of the ducting was assumed to be 18 inches. The amount of cross-sectional area occupied by the flow of condensate was assumed to be negligible. The moisture content of the gas was assumed to be equal to the adiabatic saturation content of the gas at the temperature measured. It is possible that the flow rates measured during the monitoring program are biased due to incorrect assumptions or by a damaged pitot tube. If this is the case, then the mass flow rates of the VOCs also will be biased. The Air Products facility has highly accurate measurements of the process gas entering the gas pipeline, but less accurate measurements of the gas entering the facility. It is quite possible that our flow rate measurements are biased high and/or the Air Products values for the same gas stream are biased low.

The individual extraction wells were sampled to determine the degree of spatial variability in compound concentration and gas composition in the landfill. A total of 25 extraction wells were sampled to make this determination. The average $CO_2$ and $CH_4$ concentrations were somewhat lower for the extraction wells than for the landfill gas collection system. This is primarily an artifact of the wells that extract gas from older garbage having very little flow and more air infiltration. Average $H_2S$ concentrations also were lower for the extraction wells, however, average mercury concentrations were similar to those measured in the north field header.

The average VOC concentrations in the extraction wells closely mirrored the values measured in the north and south field headers, however, there was significantly more variability in the concentrations. The %CV for the individual VOCs usually were in the 70% range, which is a much larger variability than that seen in the north and south field headers. Since the mean concentrations of the extraction wells versus the inlet to the gas plant were quite similar, a representative cross-section of wells were chosen for sampling. The average total non-methane hydrocarbon (TNMHC) mass flow rate was 27,300 $\mu$g/sec (0.027 g/sec). This equates to 2.3 kg/day of TNMHC per well or 575 kg/day for the collection system. The data from the north and south field headers indicated that 700 kg/day of TNMHC was collected. This also indicates that the wells selected for sampling were relatively representative of the overall well field.

The average mass flow rates for $CH_4$ and $CO_2$ were 5.2 and 10.1 g/sec, respectively. This translates to 450 kg/day for methane and 875 kg/day of $CO_2$ on a per well basis. Assuming approximately 250 wells (200 vertical wells plus many meters of lateral wells), this equates to 125,000 kg/day for methane and 219,000 kg/day for $CO_2$. The data from the landfill gas collection system indicate that there is 167,000 kg/day of methane and 284,000 kg/day of $CO_2$ entering the gas plant. This relatively minor difference between the two estimates is likely due to the assumption that the lateral wells are equivalent to 50 vertical wells.

Liquid condensate samples were collected from the north and south field headers and from the air/water separator, which was located immediately downstream from the header sampling locations. The air/water separator location was sampled during times when the header sampling locations were not accessible. The condensate samples were collected to more fully characterize the composition of gas within the landfill gas collection system. A total of 16 VOCs were detected in one or more of the samples. The compounds detected represent the major compounds detected in the gas samples plus several polar compounds that were not detected in appreciable concentrations in the gas samples.

Acetone, methylene chloride, 2-butanone (MEK), and methylisobutylketone (MIBK) were the four major constituents found in the condensate samples. These compounds are very water soluble, so it is not surprising that they are the major compounds detected in the samples. In general, the north header had the lowest concentrations with the south header having the highest and the air/water separator having values intermediate to the other two. The air/water separator samples represented the combination of the two headers, so the intermediate values indicate that this was a valid sampling location. During the monitoring period, Air Products was collecting between 45,000 and 53,000 liters (12,000 and 14,000 gallons) of condensate daily. The condensate was incinerated at the plant.

## 5.4 Measurement Results for Other Potential Emission Sources

There are two potential emission sources at Fresh Kills identified prior to the field work that were not sampled: perimeter vent trenches and perimeter pipes. No perimeter pipes were found during the field effort and, according to NY DOS staff, no perimeter pipes exist. Therefore, they can be dismissed as a source of air emissions.

The vent trenches were not found during the field study. Much of the landfill is surrounded by surface water. For some of the areas where the landfill is bordered by land, vent trenches are located just beyond the toe of the landfill mounds. If lateral migration of landfill gases were to occur, the vent trenches would allow the gas traveling just below the ground surface to be released to the atmosphere, thereby avoiding the safety hazard of landfill gas entering basements and other subsurface structures. Conversations with NY DOS staff indicate that total hydrocarbon (THC) screening measurements above the vent trenches have shown no measurable gas concentrations (THC detection limits typically are 1 ppmv). Furthermore, the vent trenches are covered by heavy vegetation which is evidence against the vent trenches being emission sources, since above certain concentration levels, landfill gases will kill vegetation. It is common practice to identify emission points of migrating landfill gas by looking for areas with dead vegetation. The available information indicates that the vent trenches are not a significant source of air emissions.

## 5.5 Composition of Landfill Gas

The individual measurement data were compiled and evaluated to determine the typical composition of landfill gas at Fresh Kills. The measured concentrations from the passive vents were summed and averaged, as were the measured concentrations to the gas collection plant. These data are given in Table 5-15. The data were not weighted to account for differences in flow rate among the vents. No concentration data of undiluted landfill gas was collected from the surface of the landfill, so no absolute composition data can be developed for that source (i.e., the flux chamber sampling approach involves dilution of the emitted landfill gas with sweep air and the amount of dilution varies with the sweep air flow rate). However, the relative composition of the landfill gas can be determined for flux chamber samples by converting the flux values from a mass basis to a molar basis. Table 5-16 contains the relative composition of VOCs present in the landfill gas exiting the landfill from the passive vents, from the landfill surface, and to the gas collection plant. The relative fraction of each VOC is given as a function of the total VOC. The landfill gas composition is remarkably consistent among all three measurement locations even though the emission rates for these three sources are quite different, indicating that the composition does not vary significantly as a function of landfill gas flow rate.

The best estimate of the composition of the landfill gas is the set of concentration data shown in Table 5-15 for the gas collection system. These represent integrated samples drawn from over 200 extraction wells that withdraw gas over a wide area and from a significant depth interval. In addition, the data represent averages of multiple days of measurements.

## 5.6 Overall Emissions From Fresh Kills Landfill

The total emission rates of landfill gas to the atmosphere were determined by summing the emissions from the passive vents and the emissions from the entire landfill surface. Of the two data sets, the emission rates for the passive vents are considered to be more accurate because VOC measurements were made at roughly 25% of the vents. The emissions from the landfill surface, in contrast, are based on extrapolations from a limited number of measurements that cover less than 0.0003% of the entire landfill surface. In addition, surface emissions of methane were not detected in many cases and, to be conservative, the lower detection limit for methane of 0.282% was used in those cases, which resulted in a flux of 0.158 $\mu g/m^2$-min.

The total landfill gas production rates were determined by summing the total landfill gas emission rates and the mass flow rates to the gas collection system (see Table 5-13). The landfill gas emission rate is less than the landfill gas production rate, because the landfill gases captured by the collection system are processed into pipeline quality natural gas, with the VOCs and condensate being removed from the gas stream and incinerated. However, emissions from the incinerator (carbon monoxide, any uncombusted VOCs, particulate matter, nitrogen oxides, and mercury), other sources at the landfill gas processing plant (i.e., fugitive emissions and engine emissions), the composting operations, and the small volume of waste deposited over the southern half of Section 6/7 are not included in the estimated landfill gas emission rates. With the exception of mercury emissions from the incinerator, these sources are believed to be insignificant with respect to the total landfill gas emissions. Mercury emissions are discussed later in this section. No measurements were made at the southern half of Section 6/7, but relatively small volumes of MSW were deposited in this area and dense vegetation is present, indicating no significant emissions of landfill gas.

The landfill gas emission and production rates from the landfill for all compounds measured are given in Table 5-17. TNMHC emissions from the landfill are 33.4 g/sec (1,053 Mg/yr). Several compounds are being emitted to the atmosphere at a rate greater than 0.288 g/sec (10 tons/year). Hydrogen sulfide emissions are estimated to be 0.453 g/sec (14.3 Mg/yr). As previously noted, $H_2S$ has a very low odor threshold and this level of emissions certainly contributes to the odors at the landfill. Methane is being emitted at a rate of 21,800 g/sec (0.687 Tg/yr). However, methane was not detected in 53 of the 74 flux chamber samples. For these samples, the methane detection limit of 0.282% was used to calculate methane emissions, which roughly corresponds to an emission flux of 0.158 $\mu g/m^2$-min. These non-detect measurements account for 42.6% of the methane emissions (0.293 Tg/yr).

The mass flow rate of mercury to the gas collection system was found to be 2.45 kg/day (5.4 lb/day). The mercury concentration in the landfill gas collection system averaged 0.688 ppm, while the mercury concentration in the passive vents averaged 0.373 ppm. It appears that the gas extraction system is increasing mercury volatilization relative to areas not under the influence of the gas extraction system. It is likely that the increase in mercury emissions is due to the transport distance. The gas entering the extraction wells travels a relatively short distance through MSW compared with gas that is emitted from the landfill surface. This reduces the amount of mercury that is adsorbed onto the MSW and thus removed from the gas phase.

The mercury data are based on field measurements using a portable analyzer rather than the EPA reference method. Also, a limited number of mercury measurements were made. Therefore, the data set for mercury should not be considered to be definitive.

The impending New Source Performance Standards for MSW Landfills are expected to require landfills emitting more that 50 Mg/yr of TNMHC to install gas collection systems to control NMOC emissions. Based on the measurements made at Fresh Kills, the fate of mercury in such gas collection systems is a topic that merits investigation. Of course, mercury emissions from landfills in the future should decrease as the mass of mercury being landfilled is reduced due to recycling efforts (i.e., fluorescent lamps and battery recycling) and source reduction.

In addition to elemental mercury emissions it is likely that the anaerobic environment within the landfill is converting some of the elemental mercury into organo-mercury compounds such as methyl mercury and dimethyl mercury. Many of these forms of mercury are more toxic than elemental mercury. The emissions of speciated mercury from the landfill also should be investigated.

No attempt was made to determine the fate of mercury entering the gas processing plant. The possible fate mechanisms of the mercury entering the gas plant include: 1) the mercury is removed with the VOCs and condensate, sent to the incinerator, and ultimately emitted in the exhaust gas from the incinerator; 2) the mercury is removed by the iron impregnated wood chips used in the $H_2S$ scrubber, is trucked off with the used wood chips, and ultimately disposed of in a landfill; and 3) the mercury is not removed from the processed gas and enters the natural gas pipeline.

The efficiency of the gas collection system was evaluated from the measured mass flow rates. The mass flow rate of methane to the gas collection plant is 2,090 g/sec. The measured emission flux from the surface of Section 1/9 in areas where active gas collection is taking place averaged 0.143 g/m$^2$-min over a surface area of 192,900 m$^2$. This flux equals an emission rate from the landfill surface of 460 g/sec of methane. Therefore, 82% of the landfill gas is being captured by the gas collection system.

## 5.7 Comparison of Data With Other Landfill Studies

The generation of methane and carbon dioxide from MSW has been extensively studied and a very large body of literature exists regarding the factors that influence gas production and the amount of gas that is produced per category of waste material and per mass of waste. Surprisingly few studies, however, have been identified which examined air emissions from MSW landfills. The difficulty in measuring air emissions from large, heterogeneous area sources has limited the work done to date. No studies were found that are as detailed and comprehensive as the work described in this report.

The U.S. EPA has published one compilation of composition data for landfill gas (EPA, 1990) and funded another (Kuo, 1990). The two compilations may have significant overlap and only the EPA publication has undergone extensive peer review, so that data set was selected for comparison with the Fresh Kills data. This comparison is given in Table 5-18. The comparison shows that the Fresh Kills concentrations are within the range of published values and at the low end of the range. The average TNMHC value measured at the gas collection plant was 438 ppm versus a proposed default regulatory value for landfills of 4,000 ppm.

Two studies were identified where emission fluxes were measured from the surface of MSW landfills. A field study was conducted in 1993 at a 300 acre landfill in the southwestern U.S. that accepts 1,100 metric tons/day (1,200 tons/day) of residential refuse (Schmidt, et al., 1994). Measurements were made using an emission isolation flux chamber. TNMHC fluxes were 640 to 5,400 $\mu g/m^2$-min, methane fluxes were 33 to 120 $\mu g/m^2$-min, and fluxes of about 20 individual VOCs ranged from ND to 350 $\mu g/m^2$-min. The reported values are much lower than those measured at Fresh Kills. A second field study was performed at two MSW landfills in Florida (Reinhart, et al., 1993). Methane fluxes up to 230 $\mu g/m^2$-min were measured. Again, this is far less than the values measured at Fresh Kills.

While the concentrations of pollutants in the landfill gas from Fresh Kills are lower than the average for MSW landfills, the emission fluxes are much higher, which implies that the gas generation rate for Fresh Kills is much higher than average. The shallow groundwater table and high rainfall at Fresh Kills are thought to provide adequate moisture to maintain optimal conditions for biodegradation, which in turn leads to high levels of gas production.

No field measurements are known of the efficiency of gas collection systems. Estimates of the collection efficiency range from 50 to 90% (Thorneloe and Peer, 1991), though the bases of these estimates is not known. The 82% value measured at Fresh Kills falls within the estimated range.

The total methane emissions from all MSW landfills in the U.S. has been estimated at about 13 Tg/year (15 million tons/year) based on the volume of waste disposed and published emission factors (Doorn, et al., 1994). The global methane emissions from all MSW landfills have been estimated at 39 Tg/year (Doorn and Barlaz, 1995). No data on VOC emissions was found. The methane emissions from Fresh Kills of 21,800 g/sec are equivalent to 0.687 Tg/year, or 5.7% of the estimated U.S. total and 1.8% of the estimated global total.

## 5.8 Estimation of Future Emissions

The measurements were performed over a 3-week period in July of 1995 at a time when large portions of the landfill were undergoing installation of a PVC cover passive vents, and gas collection system. Any extrapolation of the measurement data to future emissions must take into account these changes in landfill cover and emission points, or a bias might be introduced. The following paragraphs discuss estimation of annual emissions and estimation of future emissions based on the data set presented in this report.

### 5.8.1 Annual Emissions

The emission rate data in Table 5-17 are given in units of grams per second. These emission rates can be scaled up to provide emission estimates on an annual basis. A value of 1 g/sec corresponds to $3.15 \times 10^7$ g/year or 31.5 Mg/year (190 lbs/day and 69,500 lb/year). The total TNMHC emission rate of 33.4 g/sec corresponds to 1,053 Mg/year. The total TNMHC production rate of 41.4 g/sec corresponds to 1,306 Mg/year.

No measurements of long-term temporal variability were performed in this study, so no seasonal or annual correction factors were developed. The key environmental variables that might influence emissions over the course of a year are the temperature and moisture content within the landfill. However, these parameters are not thought to cause seasonal fluctuations in emissions at Fresh Kills, as explained below.

Biodegradation processes are exothermic and the heat that is generated serves to maintain biological activity during the colder months of the year. In addition, the mass of MSW and soil cover act to insulate the mound. Therefore, the landfill gas generation rate and air emissions are not expected to vary significantly between the summer and winter months due to ambient temperature effects.

The gas production rate in MSW landfills often is limited by the amount of moisture present within the landfill. Increases in soil moisture lead to increases in gas production. At the Fresh Kills landfill, however, it is believed that there is enough rainfall and/or uptake of ground water to maintain optimal conditions for microbial degradation of the MSW. This situation may change when installation of the PVC cover is complete. The cover will reduce the amount of moisture percolating down through the MSW and thereby lead to diminished gas production rates.

### 5.8.2 Future Emissions

There are many possible methods for estimating air emissions, including theoretical and empirical models. For the sake of simplicity, this discussion is limited to the use of emission factors based on the field measurement data. The EPA/Radian study was a relatively expensive undertaking and it is doubtful if similar measurement programs will be performed in the future at Fresh Kills. Therefore, it is useful if the existing data set can be used to estimate future emissions. Such estimates probably will require that a limited amount of additional measurement data be collected to update and augment the existing data set. Emission factors worth considering include:

1. Vent emissions on a per vent basis;

2. Surface flux emissions on a surface area basis;
3. Surface flux emissions on a MSW mass basis;
4. Gas collection system data on a surface area basis; and
5. Gas collection system data on a MSW mass basis.

The total emission rates shown in Table 5-17 can be evaluated to determine the relative contribution of vents and landfill surface to the total air emissions. For TNMHC, the vent emissions were 11.6% of the total and the landfill surface emissions were 88.4% of the total. The gas collection system, for comparison, accounted for an estimated 19.4% of the total landfill gas production of TNMHC for the entire landfill. These data suggest that emissions from the vents are relatively insignificant compared with emissions from the landfill surface. The relative contribution of vent emissions and surface emissions to the total should change as the PVC cover is put in place and more passive vents are installed. Even so, it will not be cost-effective nor accurate to use the existing vent data or to make additional vent measurements to estimate future emissions.

In this study, the surface flux measurements for a given section were extrapolated based on surface area to develop emission estimates for the surface of the entire landfill. This was done because surface area data were readily available and the surface area to volume ratio for the tops of the sections, where 90% of the surface emissions occur, was believed to be relatively constant across a given section. Therefore, the surface area data were used as a surrogate for MSW volume. For estimating future emissions, however, the use of surface areas and the existing emission factors could lead to an underestimation of emissions. For example, if the mounds were raised and the mass of MSW in the landfill were doubled without changing the surface area, any emission estimates based on surface area likely would be biased low. If the tops of the mounds were graded to significantly increase the surface area, any emission estimates based on surface area likely would be biased high.

Alternatively, emission factors based on the flux measurements can be multiplied by the total mass of MSW in the landfill to yield total landfill emissions. These emission factors were developed by assuming that all of the landfill gas produced by the column of waste under the flux chamber was captured by the flux chamber (i.e., there was no lateral migration of landfill gas). A subset of the flux chamber measurement data was used to generate these emission factors by using data only from areas where all air emissions are from the soil-covered landfill surface. Measurements made over areas with PVC cover or in areas with passive vents were not used. These emission factors, in terms of g/sec per kg of MSW, are given in Table 5-19. Such emission factors could be used with landfill records of the mass or volume of MSW accepted to develop emission estimates.

The landfill gas collection system provides another estimation approach. The mass of pollutants drawn to the gas plant can be scaled up to estimate the total production of gas for the entire landfill. For the reasons given above, such estimates are more valid if based on the mass or volume of MSW than if based on the surface area of the landfill.

The use of data from landfill gas collection system is, by far, the best approach for estimating future emissions. As demonstrated in Tables 5-15 and 5-16, the composition of the landfill gas is remarkably consistent, whether the gas is collected exiting a passive vent, exiting the landfill surface, or entering the gas plant. The headers to the gas plant offer an integrated sample that is representative of a large volume of the landfill. Given the little short-term temporal variability observed in the composition of the gas going to the plant, it might be possible to track the mass flow using only flow rate measurements without the need for regular (and costly) analysis of gas samples. Any such estimates would have to be corrected over time for the changes in the fraction of the total landfill under the influence of the gas collection system.

Emission estimates were developed using two different approaches: emission factors based on flux chamber measurements and emission rates based on gas plant data. These emission estimates are given in Table 5-20 along with the emission total based on the field measurements. The comparison of the results shows that emission factors based on gas plant data yield results that are similar to the field measurements. The emission factors based on flux chamber measurements yield total emission estimates that are two to three orders of magnitude greater than the field measurements. This high bias may be due to the small number of measurements used to develop these emission factors and the representativeness of these measurements. The data from the gas plant provides the best estimation tool for predicting future emissions.

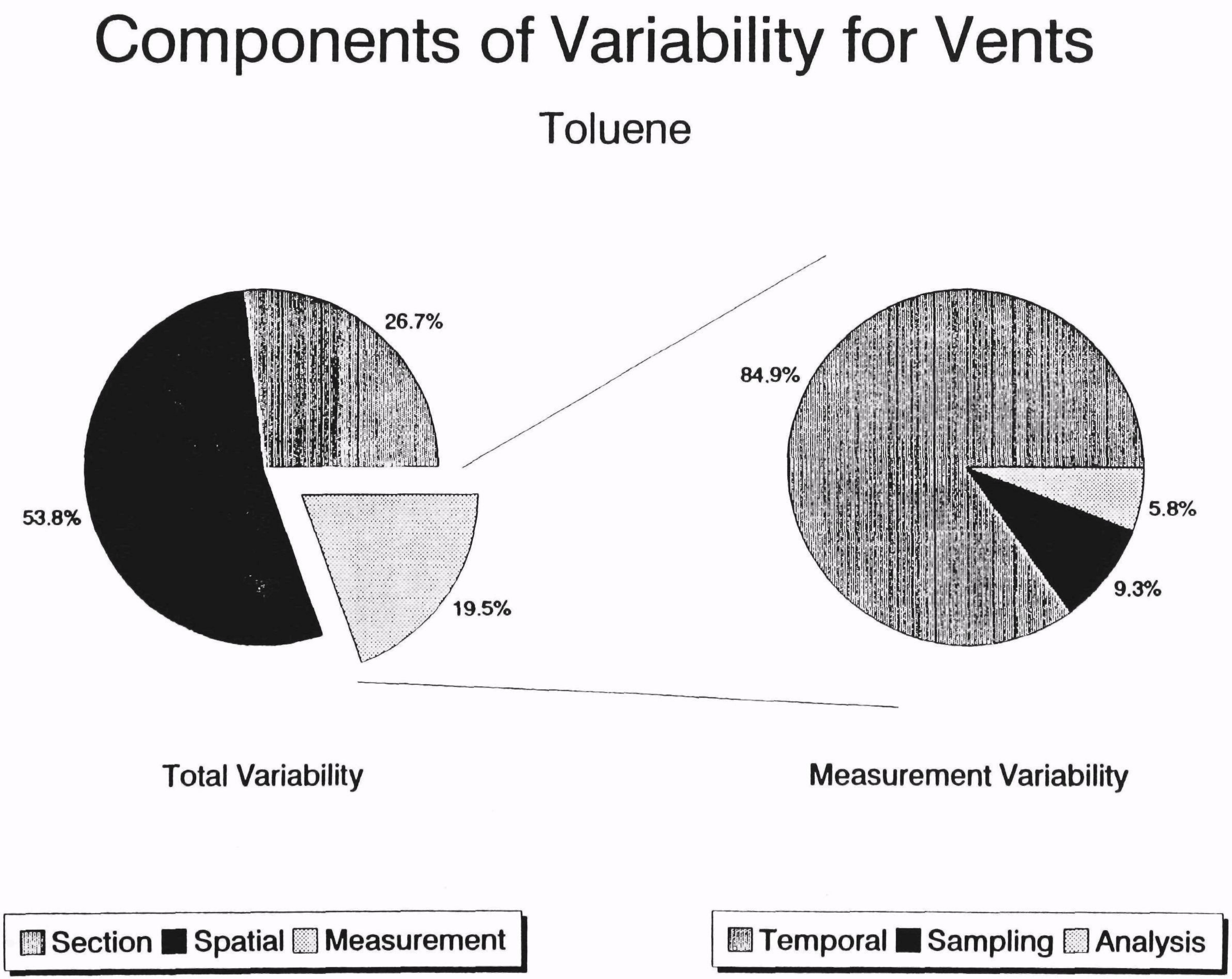


**Figure 5-1. Variability in Emissions from Passive Vents**

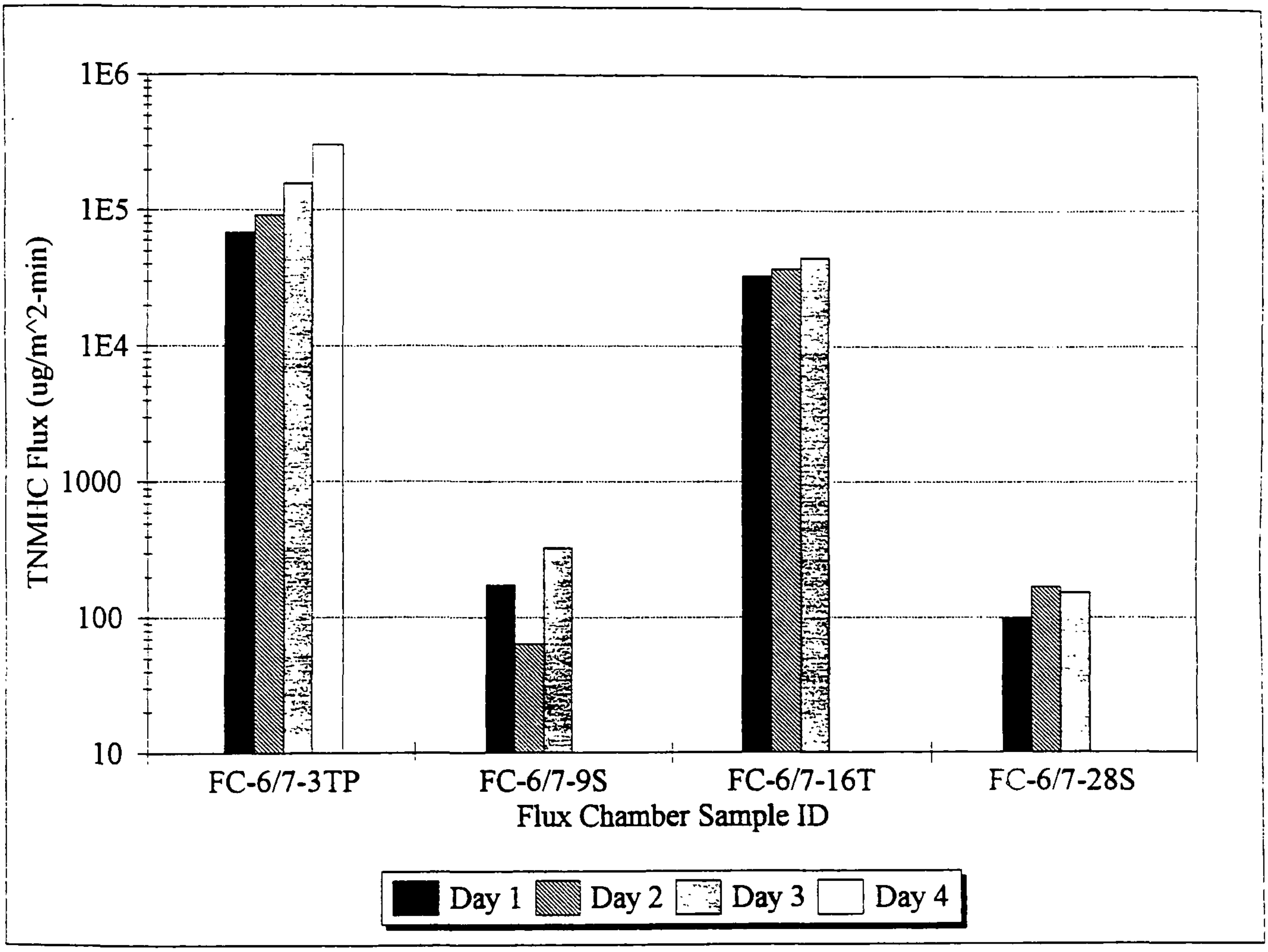


**Figure 5-2. Temporal Variability in TNMHC Emission Flux from Section 6/7**

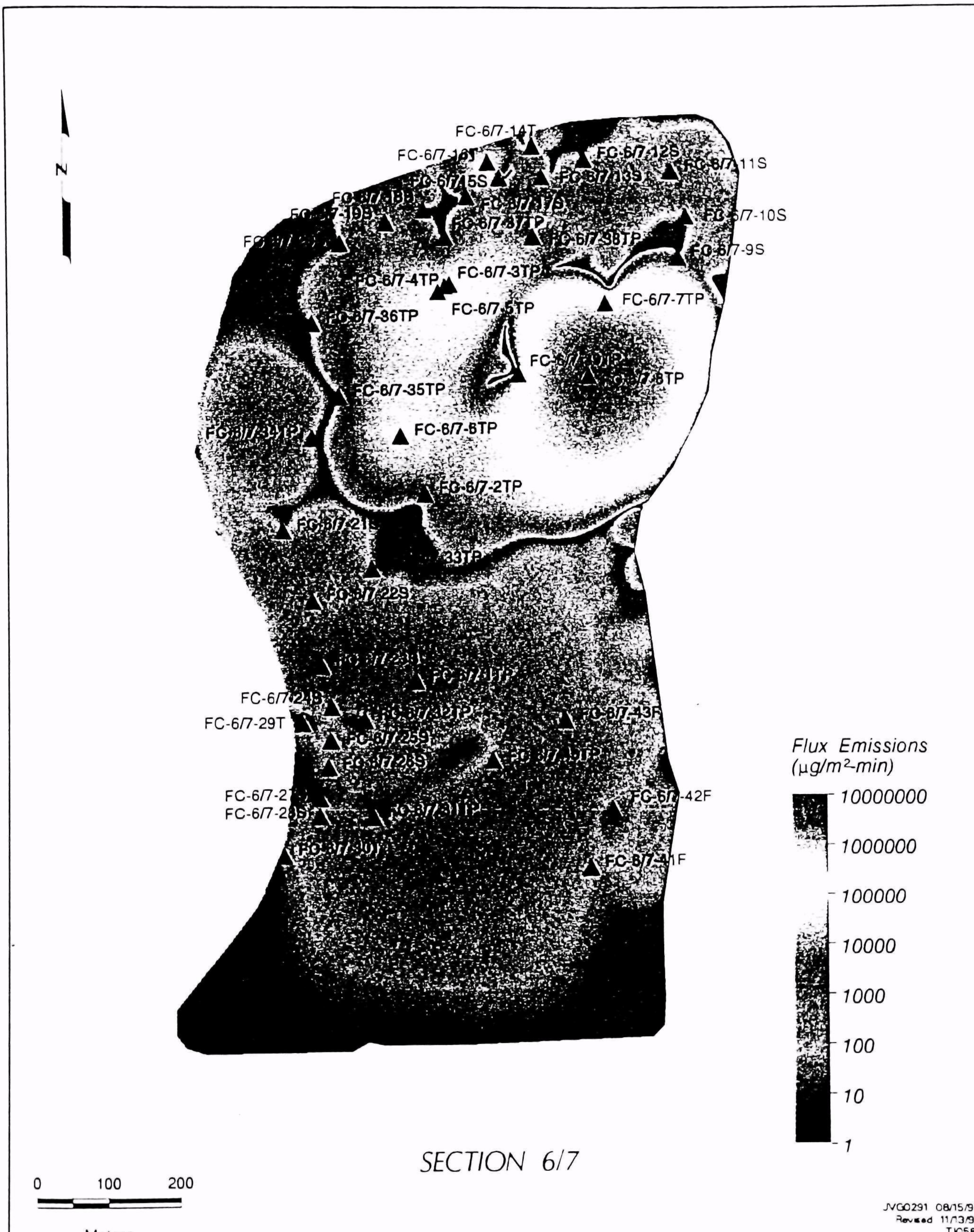


**Figure 5-3. Spatial Variability of Surface TNMHC Flux Emissions for Landfill Section 6/7**

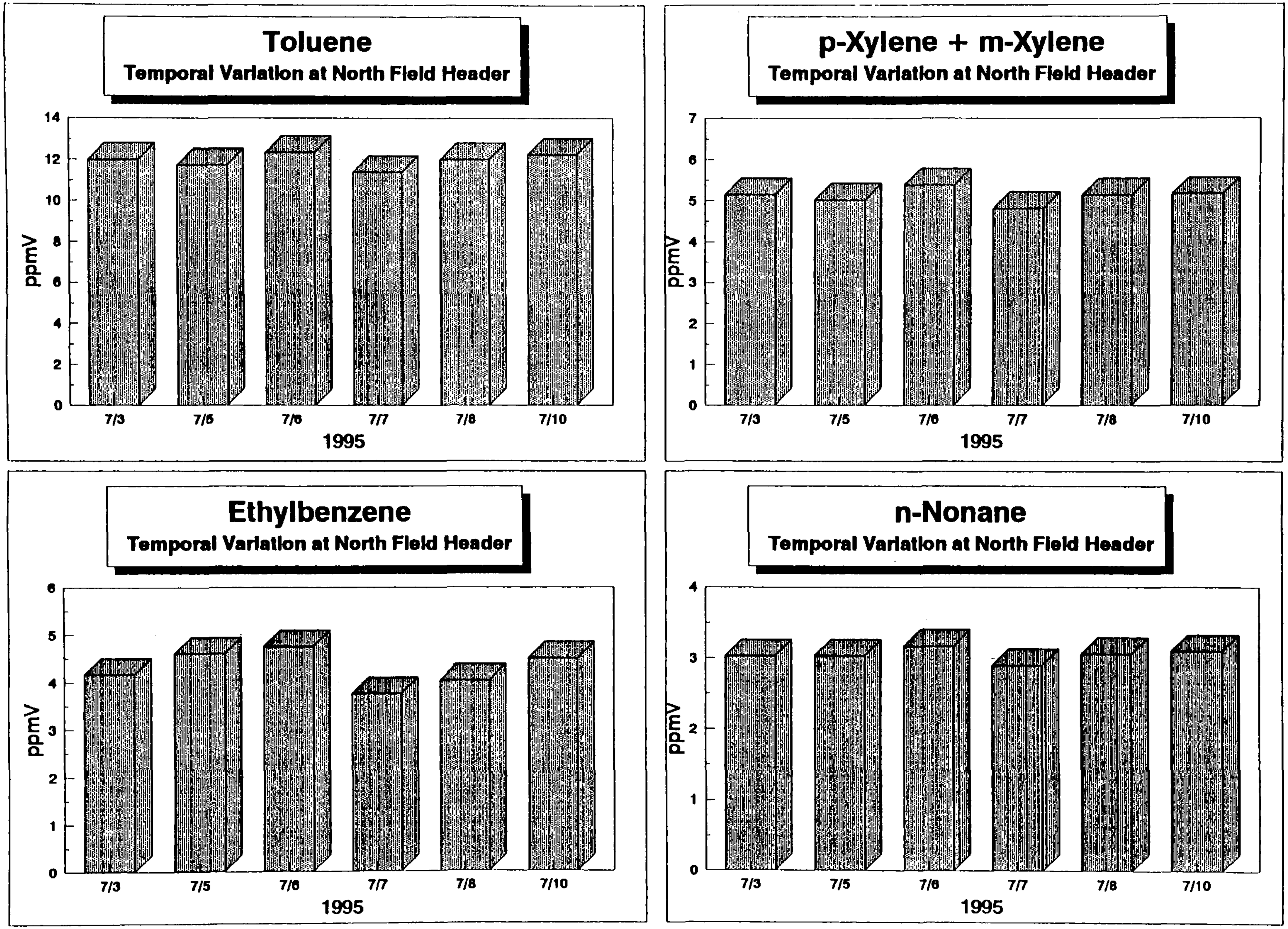


**Figure 5-4. Variability in VOC Concentration Extracted Gas**

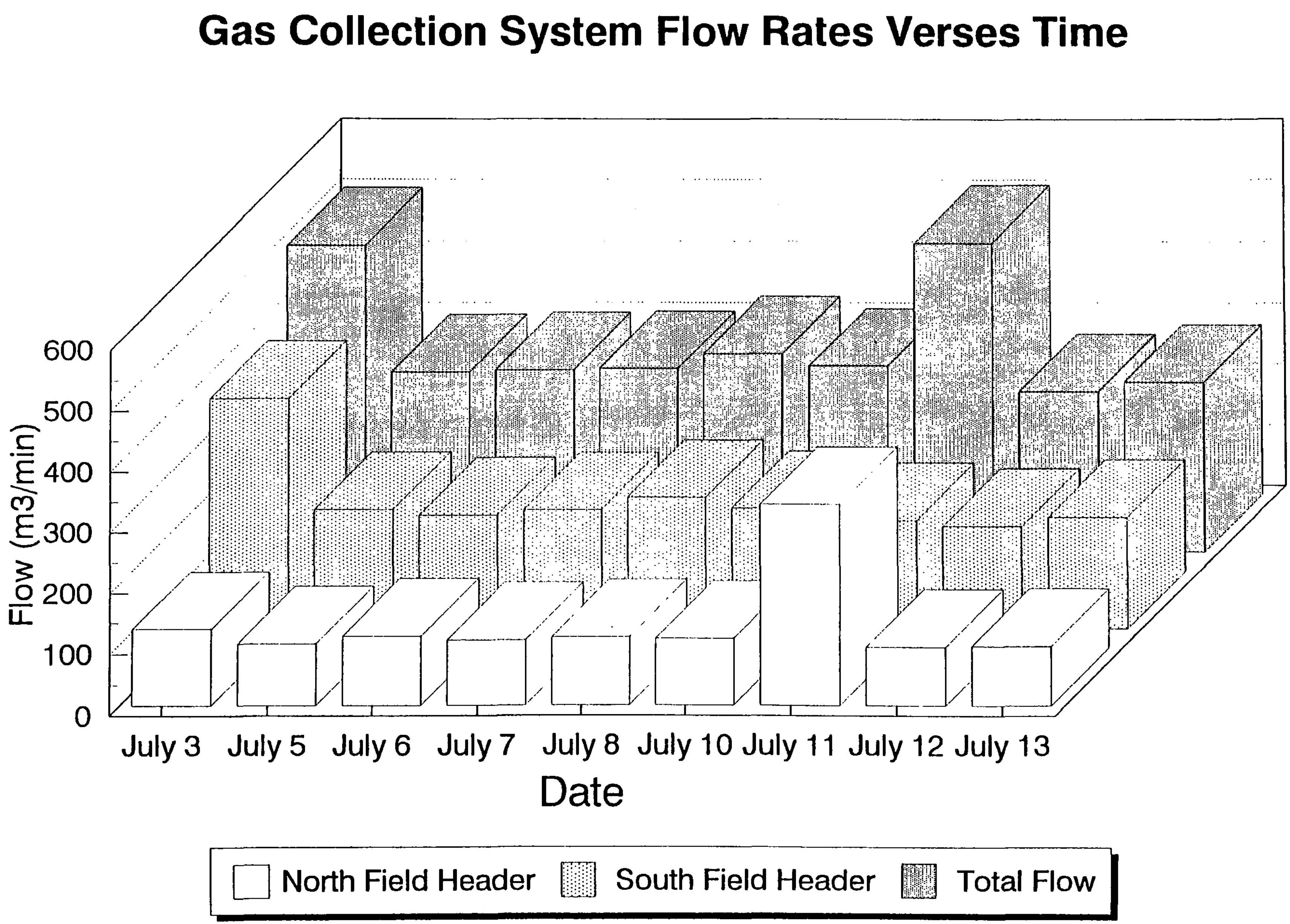


**Figure 5-5. Temporal Variability in Gas Collection System Flow Rates**

## Table 5-1
## Emission Rates from Passive Vents at Section 1/9

| Compound | Total Emission Rate[b] (μg/sec) | Factor[c] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| | | No. Vents with Flow | 7 | 8 | 0 | 14 | 1 | 0 |
| Methane | 32.5 g/sec | Avg. E.F. | 2.70 | 1.69 | 0 | 2.16 | 2.28 | 0 |
| | | E.R. (g/sec) | 18.9 | 13.5 | 0 | 30.2 | 2.28 | 0 |
| Carbon dioxide | 62.8 g/sec | Avg. E.F. | 5.24 | 3.26 | 0 | 4.18 | 4.19 | 0 |
| | | E.R. (g/sec) | 36.7 | 26.1 | 0 | 58.6 | 4.19 | 0 |
| Oxygen | 8.44 g/sec | Avg. E.F. | 0.676 | 0.463 | 0 | 0.603 | 0 | 0 |
| | | E.R. (g/sec) | 4.73 | 3.70 | 0 | 8.44 | 0 | 0 |
| Hydrogen sulfide | 3360 | Avg. E.F. | 282 | 173 | 0 | 225 | 207 | 0 |
| | | E.R. (μg/sec) | 1,970 | 1,380 | 0 | 3,150 | 207 | 0 |
| Mercury | 315 | Avg. E.F. | --[a] | 21.0 | 0 | 7.40 | 48.4 | 0 |
| | | E.R. (μg/sec) | 147 | 168 | 0 | 104 | 48.4 | 0 |
| Benzene | 230 | Avg. E.F. | --[a] | 15.3 | 0 | 15.0 | 17.1 | 0 |
| | | E.R. (μg/sec) | 107 | 122 | 0 | 209 | 17.1 | 0 |
| Benzyl chloride & m-Dichlorobenzene | 926 | Avg. E.F. | --[a] | 61.8 | 0 | 64.1 | 50.1 | 0 |
| | | E.R. (μg/sec) | 432 | 494 | 0 | 897 | 50.1 | 0 |
| Chlorobenzene | 513 | Avg. E.F. | --[a] | 34.2 | 0 | 32.4 | 43.4 | 0 |
| | | E.R. (μg/sec) | 239 | 274 | 0 | 453 | 43.4 | 0 |
| n-Decane & p-Dichlorobenzene | 6,540 | Avg. E.F. | --[a] | 436 | 0 | 441 | 408 | 0 |
| | | E.R. (μg/sec) | 3,050 | 3,490 | 0 | 6,180 | 408 | 0 |

# Table 5-1
# (Continued)

| Compound | Total Emission Rate[b] (µg/sec) | Factor[c] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| 1,1-Dichloroethane | 1.55 | Avg. E.F. | --[a] | 0.103 | 0 | 0.124 | 0 | 0 |
| | | E.R. (µg/sec) | 0.723 | 0.827 | 0 | 1.74 | 0 | 0 |
| 1,1-Dichloroethylene | 0 | Avg. E.F. | --[a] | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (µg/sec) | 0 | 0 | 0 | 0 | 0 | 0 |
| c-1,2-Dichloroethylene | 4.23 | Avg. E.F. | --[a] | 0.282 | 0 | 0.338 | 0 | 0 |
| | | E.R. (µg/sec) | 1.97 | 2.25 | 0 | 4.73 | 0 | 0 |
| Ethylbenzene | 1680 | Avg. E.F. | --[a] | 112 | 0 | 112 | 110 | 0 |
| | | E.R. (µg/sec) | 783 | 895 | 0 | 1,570 | 110 | 0 |
| Methylene chloride | 0 | Avg. E.F. | --[a] | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (µg/sec) | 0 | 0 | 0 | 0 | 0 | 0 |
| n-Nonane | 1,640 | Avg. E.F. | --[a] | 110 | 0 | 116 | 78.8 | 0 |
| | | E.R. (µg/sec) | 767 | 877 | 0 | 1,620 | 78.8 | 0 |
| Styrene | 327 | Avg. E.F. | --[a] | 21.8 | 0 | 21.5 | 23.4 | 0 |
| | | E.R. (µg/sec) | 153 | 174 | 0 | 300 | 23.4 | 0 |
| Toluene | 581 | Avg. E.F. | --[a] | 38.7 | 0 | 42.0 | 22.2 | 0 |
| | | E.R. (µg/sec) | 271 | 310 | 0 | 588 | 22.23 | 0 |
| 1,1,1-Trichloroethane | 0 | Avg. E.F. | --[a] | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (µg/sec) | 0 | 0 | 0 | 0 | 0 | 0 |

# Table 5-1
## (Continued)

| Compound | Total Emission Rate[b] (µg/sec) | Factor[c] | Emissions by Feature: Top | Emissions by Feature: Side | Emissions by Feature: Toe | Emissions by Cover Material: Soil | Emissions by Cover Material: Clay | Emissions by Cover Material: Liner |
|---|---|---|---|---|---|---|---|---|
| Trichloroethene | 0 | Avg. E.F. | --[a] | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (µg/sec) | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 2160 | Avg. E.F. | --[a] | 144 | 0 | 137 | 180 | 0 |
| | | E.R. (µg/sec) | 1,010 | 1,150 | 0 | 1,920 | 180 | 0 |
| n-Undecane | 1470 | Avg. E.F. | --[a] | 97.8 | 0 | 101 | 80.1 | 0 |
| | | E.R. (µg/sec) | 685 | 783 | 0 | 1,420 | 80.1 | 0 |
| Vinyl chloride | 29.1 | Avg. E.F. | --[a] | 1.94 | 0 | 1.49 | 4.20 | 0 |
| | | E.R. (µg/sec) | 13.6 | 15.5 | 0 | 20.9 | 4.20 | 0 |
| o-Xylene | 814 | Avg. E.F. | --[a] | 54.3 | 0 | 55.3 | 49.3 | 0 |
| | | E.R. (µg/sec) | 380 | 434 | 0 | 774 | 49.3 | 0 |
| p/m-Xylene | 2000 | Avg. E.F. | --[a] | 133 | 0 | 136 | 119 | 0 |
| | | E.R. (µg/sec) | 934 | 1,070 | 0 | 1,910 | 119 | 0 |
| TNMHC | 85100 | Avg. E.F. | --[a] | 5,670 | 0 | 5,570 | 6,220 | 0 |
| | | E.R. (µg/sec) | 39,700 | 45,400 | 0 | 77,900 | 6,220 | 0 |

[a] - No samples were collected from vents on top of Section 1/9, so the emission factor from the side vents was used.
[b] - Total emission rate = emissions from top + side + toe = emissions from soil + clay + liner areas
[c] - No. vents with flow is the activity factor and equals the total number of vents that had measureable flow when tested.

Avg E.F. = average emission factor in units of g/sec per vent or µg/sec per vent
E.R. is emission rate = activity factor x emission factor

# Table 5-2
## Emission Rates from Passive Vents at Section 2/8

| Compound | Total Emission Rate[b] (µg/sec) | Factor[c] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| | | No. Vents with Flow | 29 | 46 | 4 | 43 | 9 | 27 |
| Methane | 482 g/sec | Avg. E.F. | 8.65 | 4.78 | 2.79 | 5.27 | 4.33 | 8.02 |
| | | E.R. (g/sec) | 251 | 220 | 11.1 | 226 | 39.0 | 217 |
| Carbon dioxide | 952 g/sec | Avg. E.F. | 17.0 | 9.45 | 6.19 | 10.4 | 9.13 | 15.7 |
| | | E.R. (g/sec) | 493 | 435 | 24.8 | 447 | 82.2 | 423 |
| Oxygen | 22.0 g/sec | Avg. E.F. | 0.0683 | 0.412 | 0.254 | 0.487 | 0.104 | 0.00295 |
| | | E.R. (g/sec) | 1.98 | 19.0 | 1.02 | 21.0 | 0.940 | 0.0795 |
| Hydrogen sulfide | 69700 | Avg. E.F. | 1,260 | 688 | 367 | 778 | 374 | 1,220 |
| | | E.R. (µg/sec) | 36,600 | 31,700 | 1,470 | 33,400 | 3,370 | 32,900 |
| Mercury | 2840 | Avg. E.F. | 31.2 | 38.7 | --[a] | 36.6 | 64.3 | 27.7 |
| | | E.R. (µg/sec) | 904 | 1,780 | 155 | 1,570 | 579 | 748 |
| Benzene | 2080 | Avg. E.F. | 37.3 | 19.3 | 27.7 | 26.4 | 14.6 | 30.1 |
| | | E.R. (µg/sec) | 1,080 | 888 | 111 | 1,130 | 131 | 813 |
| Benzyl chloride & m-Dichlorobenzene | 8770 | Avg. E.F. | 139 | 96.4 | 77.5 | 102 | 57.6 | 151 |
| | | E.R. (µg/sec) | 4,030 | 4,430 | 310 | 4,390 | 518 | 4,080 |
| Chlorobenzene | 12600 | Avg. E.F. | 230 | 120 | 107 | 158 | 114 | 181 |
| | | E.R. (µg/sec) | 6,670 | 5,520 | 427 | 6,810 | 1,030 | 4,900 |

# Table 5-2
## (Continued)

| Compound | Total Emission Rate[b] (µg/sec) | Factor[c] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| n-Decane & p-Dichlorobenzene | 76800 | Avg. E.F. | 1,290 | 850 | 103 | 910 | 512 | 1,330 |
| | | E.R. (µg/sec) | 37,300 | 39,100 | 410 | 39,100 | 4,610 | 35,900 |
| 1,1-Dichloroethane | 6280 | Avg. E.F. | 143 | 45.8 | 2.95 | 99.7 | 4.71 | 65.0 |
| | | E.R. (µg/sec) | 4,160 | 2,110 | 11.8 | 4,290 | 42.4 | 1,760 |
| 1,1-Dichloroethylene | 138 | Avg. E.F. | 2.83 | 1.20 | 0 | 1.78 | 1.38 | 1.90 |
| | | E.R. (µg/sec) | 82.2 | 55.2 | 0 | 76.6 | 12.4 | 51.4 |
| c-1,2-Dichloroethylene | 7780 | Avg. E.F. | 132 | 86.0 | 0 | 90.1 | 153 | 106 |
| | | E.R. (µg/sec) | 3,820 | 3,960 | 0 | 3,870 | 1,380 | 2,860 |
| Ethylbenzene | 35500 | Avg. E.F. | 541 | 391 | 462 | 383 | 422 | 606 |
| | | E.R. (µg/sec) | 15,700 | 18,000 | 1,850 | 16,500 | 3,800 | 16,400 |
| Methylene chloride | 9810 | Avg. E.F. | 256 | 52.0 | 0 | 172 | 5.76 | 66.3 |
| | | E.R. (µg/sec) | 7,420 | 2,390 | 0 | 7,400 | 51.8 | 1,790 |
| n-Nonane | 36500 | Avg. E.F. | 646 | 363 | 273 | 430 | 342 | 588 |
| | | E.R. (µg/sec) | 18,700 | 16,700 | 1,090 | 18,500 | 3,080 | 15,900 |
| Styrene | 16200 | Avg. E.F. | 298 | 156 | 83.1 | 198 | 125 | 255 |
| | | E.R. (µg/sec) | 8,650 | 7,190 | 332 | 8,530 | 1,120 | 6,870 |
| Toluene | 123000 | Avg. E.F. | 2,250 | 1,260 | 57.1 | 1,480 | 1,270 | 1,940 |
| | | E.R. (µg/sec) | 65,200 | 57,800 | 228 | 63,700 | 11,500 | 52,300 |

# Table 5-2
# (Continued)

| Compound | Total Emission Rate[b] (μg/sec) | Factor[c] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| 1,1,1-Trichloroethane | 1380 | Avg. E.F. | 27.3 | 12.7 | 0 | 19.3 | 2.84 | 19.6 |
| | | E.R. (μg/sec) | 793 | 585 | 0 | 828 | 25.5 | 528 |
| Trichloroethene | 4500 | Avg. E.F. | 99.1 | 35.4 | 0 | 66.5 | 30.5 | 49.1 |
| | | E.R. (μg/sec) | 2,870 | 1,630 | 0 | 2,860 | 274 | 1,330 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 25800 | Avg. E.F. | 399 | 277 | 362 | 296 | 150 | 451 |
| | | E.R. (μg/sec) | 11,600 | 12,800 | 1,450 | 12,700 | 1,350 | 12,200 |
| n-Undecane | 16300 | Avg. E.F. | 245 | 189 | 128 | 192 | 69.7 | 289 |
| | | E.R. (μg/sec) | 7,100 | 8,700 | 513 | 8,270 | 627 | 7,810 |
| Vinyl chloride | 7280 | Avg. E.F. | 129 | 77.0 | 0 | 93.8 | 102 | 92.0 |
| | | E.R. (μg/sec) | 3,740 | 3,540 | 0 | 4,040 | 915 | 2,480 |
| o-Xylene | 20600 | Avg. E.F. | 307 | 239 | 165 | 224 | 207 | 366 |
| | | E.R. (μg/sec) | 8,910 | 11,000 | 662 | 9,650 | 1,860 | 9,870 |
| p/m-Xylene | 55600 | Avg. E.F. | 857 | 624 | 488 | 590 | 744 | 956 |
| | | E.R. (μg/sec) | 24,900 | 28,700 | 1,950 | 25,400 | 6,700 | 25,800 |
| TNMHC | 1970000 | Avg. E.F. | 34,800 | 19,900 | 11,500 | 25,200 | 12,500 | 29,700 |
| | | E.R. (μg/sec) | 1,010,000 | 918,000 | 46,100 | 1,080,000 | 113,000 | 802,000 |

[a] - No Hg samples were collected from vents on toe of Section 2/8, so the emission factor from the side vents was used.
[b] - Total emission rate = emissions from top + side + toe = emissions from soil + clay + liner areas
[c] - No. vents with flow is the activity factor and equals the total number of vents that had measureable flow when tested.

Avg E.F. = average emission factor in units of g/sec per vent or μg/sec per vent

## Table 5-3
## Emission Rates from Passive Vents at Section 3/4

| Compound | Total Emission Rate[a] (µg/sec) | Factor[b] | Emissions by Feature: Top | Emissions by Feature: Side | Emissions by Feature: Toe | Emissions by Cover Material: Soil | Emissions by Cover Material: Clay | Emissions by Cover Material: Liner |
|---|---|---|---|---|---|---|---|---|
| | | No. Vents with Flow | 17 | 50 | 11 | 44 | 10 | 24 |
| Methane | 427 g/sec | Avg. E.F. | 8.41 | 5.05 | 2.87 | 5.04 | 5.24 | 6.38 |
| | | E.R. (g/sec) | 143 | 253 | 31.6 | 222 | 52.4 | 153 |
| Carbon dioxide | 803 g/sec | Avg. E.F. | 15.5 | 9.64 | 5.25 | 9.60 | 9.90 | 11.7 |
| | | E.R. (g/sec) | 263.5 | 482 | 57.7 | 423 | 99.0 | 282 |
| Oxygen | 22.4 g/sec | Avg. E.F. | 0.278 | 0.311 | 0.189 | 0.419 | 0.0191 | 0.156 |
| | | E.R. (g/sec) | 4.73 | 15.6 | 2.08 | 18.4 | 0.191 | 3.75 |
| Hydrogen sulfide | 79700 | Avg. E.F. | 1,470 | 957 | 620 | 898 | 949 | 1,280 |
| | | E.R. (µg/sec) | 25,000 | 47,900 | 6,820 | 39,500 | 9,490 | 30,700 |
| Mercury | 2290 | Avg. E.F. | 23.0 | 37.9 | 0 | 26.6 | 46.1 | 34.0 |
| | | E.R. (µg/sec) | 391 | 1,895 | 0 | 1,170 | 461 | 816 |
| Benzene | 1960 | Avg. E.F. | 36.9 | 24.4 | 10.6 | 27.5 | 31.8 | 27.0 |
| | | E.R. (µg/sec) | 627 | 1,220 | 117 | 1,210 | 318 | 648 |
| Benzyl chloride & m-Dichlorobenzene | 13900 | Avg. E.F. | 313 | 155 | 74.6 | 223 | 141 | 193 |
| | | E.R. (µg/sec) | 5,330 | 7,770 | 820 | 9,820 | 1,410 | 4,640 |
| Chlorobenzene | 12300 | Avg. E.F. | 252 | 148 | 55.6 | 183 | 212 | 157 |
| | | E.R. (µg/sec) | 4,280 | 7,390 | 612 | 8,030 | 2,120 | 3,770 |

# Table 5-3
## (Continued)

| Compound | Total Emission Rate[a] (µg/sec) | Factor[b] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| n-Decane & p-Dichlorobenzene | 105000 | Avg. E.F. | 2,160 | 1,340 | 60.2 | 1,560 | 1,260 | 1,550 |
| | | E.R. (µg/sec) | 36,800 | 67,200 | 662 | 68,700 | 12,600 | 37,300 |
| 1,1-Dichloroethane | 1010 | Avg. E.F. | 32.4 | 9.06 | 0.623 | 20.8 | 4.44 | 12.9 |
| | | E.R. (µg/sec) | 551 | 453 | 6.86 | 914 | 44.4 | 309 |
| 1,1-Dichloroethylene | 50.6 | Avg. E.F. | 1.52 | 0.496 | 0 | 0.591 | 0.383 | 1.52 |
| | | E.R. (µg/sec) | 25.8 | 24.8 | 0 | 26.0 | 3.83 | 36.6 |
| c-1,2-Dichloroethylene | 1860 | Avg. E.F. | 43.4 | 22.2 | 1.52 | 26.6 | 48.0 | 25.0 |
| | | E.R. (µg/sec) | 738 | 1,110 | 16.7 | 1,170 | 480 | 601 |
| Ethylbenzene | 41900 | Avg. E.F. | 829 | 554 | 11.1 | 627 | 635 | 550 |
| | | E.R. (µg/sec) | 14,100 | 27,700 | 122 | 27,600 | 6,350 | 13,200 |
| Methylene chloride | 157 | Avg. E.F. | 5.25 | 1.36 | 0 | 3.58 | 0.377 | 1.49 |
| | | E.R. (µg/sec) | 89.3 | 67.8 | 0 | 158 | 3.77 | 35.6 |
| n-Nonane | 43700 | Avg. E.F. | 884 | 567 | 34.7 | 656 | 807 | 534 |
| | | E.R. (µg/sec) | 15,000 | 28,300 | 382 | 28,900 | 8,070 | 12,800 |
| Styrene | 11800 | Avg. E.F. | 255 | 136 | 64.2 | 175 | 210 | 158 |
| | | E.R. (µg/sec) | 4,330 | 6,780 | 706 | 7,710 | 2,100 | 3,780 |
| Toluene | 77200 | Avg. E.F. | 1,730 | 954 | 7.89 | 1,260 | 1,530 | 802 |
| | | E.R. (µg/sec) | 29,400 | 47,700 | 86.8 | 55,400 | 15,300 | 19,300 |

# Table 5-3
# (Continued)

| Compound | Total Emission Rate[a] (µg/sec) | Factor[b] | Emissions by Feature | | | Emissions by Cover Material | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Side | Toe | Soil | Clay | Liner |
| 1,1,1-Trichloroethane | 446 | Avg. E.F. | 16.2 | 3.33 | 0.373 | 9.17 | 0.373 | 7.50 |
| | | E.R. (µg/sec) | 275 | 166 | 4.11 | 403 | 3.73 | 180 |
| Trichloroethene | 806 | Avg. E.F. | 25.1 | 7.36 | 1.13 | 14.0 | 5.72 | 14.6 |
| | | E.R. (µg/sec) | 426 | 368 | 12.4 | 617 | 57.2 | 351 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 35100 | Avg. E.F. | 704 | 443 | 90.9 | 512 | 448 | 518 |
| | | E.R. (µg/sec) | 12,000 | 22,100 | 1,000 | 22,500 | 4,480 | 12,400 |
| n-Undecane | 21800 | Avg. E.F. | 481 | 267 | 23 | 333 | 170 | 356 |
| | | E.R. (µg/sec) | 8,180 | 13,300 | 255 | 14,700 | 1,700 | 8,540 |
| Vinyl chloride | 5570 | Avg. E.F. | 92.2 | 79.9 | 0.917 | 70.7 | 257 | 31.4 |
| | | E.R. (µg/sec) | 1,570 | 4,000 | 10.1 | 3,110 | 2,570 | 754 |
| o-Xylene | 21200 | Avg. E.F. | 434 | 274 | 10.7 | 317 | 410 | 258 |
| | | E.R. (µg/sec) | 7,370 | 13,700 | 118 | 14,000 | 4,100 | 6,180 |
| p/m-Xylene | 57500 | Avg. E.F. | 1,120 | 766 | 10.6 | 849 | 1,160 | 673 |
| | | E.R. (µg/sec) | 19,000 | 38,300 | 116 | 37,300 | 11,600 | 16,200 |
| TNMHC | 1830000 | Avg. E.F. | 40,100 | 21,900 | 4,910 | 27,900 | 26,100 | 25,800 |
| | | E.R. (µg/sec) | 681,000 | 1,090,000 | 54,000 | 1,230,000 | 261,000 | 618,000 |

[a] - Total emission rate = emissions from top + side + toe = emissions from soil + clay + liner areas
[b] - No. vents with flow is the activity factor and equals the total number of vents that had measureable flow when tested.

Avg E.F. = average emission factor in units of g/sec per vent or µg/sec per vent
E.R. is emission rate = activity factor x emission factor

## Table 5-4
## Summary of Measured Emission Rates for Passive Vents

| Compound | Units | Section 1/9 Emission Rate | Section 2/8 Emission Rate | Section 3/4 Emission Rate | Section 6/7 Emission Rate | Entire Landfill Emission Rate |
|---|---|---|---|---|---|---|
| Methane | g/sec | 32.5 | 482 | 427 | 0 | 942 |
| Carbon dioxide | g/sec | 62.8 | 952 | 803 | 0 | 1,820 |
| Oxygen | g/sec | 8.44 | 22.0 | 22.4 | 0 | 52.8 |
| Hydrogen sulfide | μg/sec | 3,360 | 69,700 | 79,700 | 0 | 153,000 |
| Mercury | μg/sec | 315 | 2,840 | 2,290 | 0 | 5,450 |
| Benzene | μg/sec | 230 | 2,080 | 1,960 | 0 | 4,270 |
| Benzyl chloride & m-Dichlorobenzene | μg/sec | 926 | 8,770 | 13,900 | 0 | 23,600 |
| Chlorobenzene | μg/sec | 513 | 12,600 | 12,300 | 0 | 25,400 |
| n-Decane & p-Dichlorobenzene | μg/sec | 6,540 | 76,800 | 105,000 | 0 | 188,000 |
| 1,1-Dichloroethane | μg/sec | 1.55 | 6,280 | 1,010 | 0 | 7,290 |
| 1,1-Dichloroethylene | μg/sec | 0 | 138 | 50.6 | 0 | 188 |
| c-1,2-Dichloroethylene | μg/sec | 4.23 | 7,780 | 1,860 | 0 | 9,640 |
| Ethylbenzene | μg/sec | 1,680 | 35,500 | 41,900 | 0 | 79,100 |
| Methylene chloride | μg/sec | 0 | 9,810 | 157 | 0 | 9,970 |
| n-Nonane | μg/sec | 1,640 | 36,500 | 43,700 | 0 | 81,900 |
| Styrene | μg/sec | 327 | 16,200 | 11,800 | 0 | 28,300 |
| Toluene | μg/sec | 581 | 123,000 | 77,200 | 0 | 201,000 |
| 1,1,1-Trichloroethane | μg/sec | 0 | 1,380 | 446 | 0 | 1,820 |
| Trichloroethene | μg/sec | 0 | 4,500 | 806 | 0 | 5,310 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | μg/sec | 2,160 | 25,800 | 35,100 | 0 | 63,100 |
| n-Undecane | μg/sec | 1,470 | 16,300 | 21,800 | 0 | 39,500 |
| Vinyl chloride | μg/sec | 29.1 | 7,280 | 5,570 | 0 | 12,900 |
| o-Xylene | μg/sec | 814 | 20,600 | 21,200 | 0 | 42,600 |
| p/m-Xylene | μg/sec | 2,000 | 55,600 | 57,500 | 0 | 115,000 |
| TNMHC | μg/sec | 85,100 | 1,970,000 | 1,830,000 | 0 | 3,890,000 |

# Table 5-5
## Variability in Measurement Data for Passive Vents

| Analyte | Sources of Variability Based on Concentration Measurements (%CV) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | Section | Spatial | Temporal | Sampling | Analytical | Measurement[1] |
| Flow Rate | 55.8 | 9.6 | 35.1 | 42.3 | --- | --- | 42.3 |
| Methane | 26.2 | 0.0 | 25.9 | 3.6 | --- | --- | 3.6 |
| Carbon Dioxide | 25.0 | 0.0 | 24.7 | 3.7 | --- | --- | 3.7 |
| Oxygen | 214.5 | 0.0 | 214.2 | 11.4 | --- | --- | 11.4 |
| Hydrogen Sulfide | 81.8 | 22.6 | 68.4 | 38.2 | 6.5 | --- | 38.7 |
| Mercury | 130.2 | 45.9 | 44.5 | 99.9 | 53.8 | --- | 113.5 |
| 1,1,1-Trichloroethane | 143.7 | 65.3 | 126.5 | 14.9 | 10.8 | 6.8 | 19.6 |
| 1,1-Dichloroethane | 173.6 | 89.4 | 148.0 | 15.6 | 2.7 | 3.0 | 16.1 |
| 1,1-Dichloroethylene | 105.2 | 42.9 | 73.6 | 55.6 | 17.7 | 20.8 | 62.0 |
| 1,2,4-Trimethylbenzene | 59.2 | 27.1 | 48.5 | 18.2 | 7.6 | 5.8 | 20.5 |
| Benzene | 47.1 | 11.6 | 43.6 | 10.7 | 0.0 | 8.3 | 13.5 |
| Benzyl Chloride & m-Dichlorobenzene | 70.2 | 38.5 | 32.6 | 39.7 | 0.0 | 28.5 | 48.8 |
| Chlorobenzene | 41.9 | 0.0 | 39.6 | 13.0 | 3.6 | 2.5 | 13.7 |
| Ethylbenzene | 58.0 | 10.5 | 52.4 | 22.3 | 0.0 | 3.7 | 22.6 |
| Methylene Chloride | 301.2 | 116.6 | 277.0 | 18.1 | 0.0 | 8.2 | 19.9 |
| Styrene | 55.6 | 12.1 | 51.0 | 16.7 | 5.8 | 5.2 | 18.4 |
| Toluene | 71.4 | 30.2 | 60.8 | 21.9 | 2.4 | 1.5 | 22.0 |
| Trichloroethane | 153.2 | 99.0 | 114.3 | 22.3 | 6.7 | 8.3 | 24.7 |

# Table 5-5
# (Continued)

| Analyte | Sources of Variability Based on Concentration Measurements (%CV) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | Section | Spatial | Temporal | Sampling | Analytical | Measurement[1] |
| Vinyl Chloride | 94.5 | 0.0 | 89.3 | 26.6 | 2.2 | 15.8 | 31.0 |
| c-1,2-Dichloroethylene | 168.8 | 95.1 | 134.6 | 28.4 | 22.2 | 4.4 | 36.3 |
| n-Decane & p-Dichlorobenzene | 60.2 | 23.2 | 48.1 | 6.7 | 26.8 | 2.9 | 27.8 |
| n-Nonane | 52.7 | 13.1 | 48.5 | 15.5 | 3.5 | 1.5 | 16.0 |
| n-Undecane | 73.5 | 27.5 | 57.8 | 0.0 | 20.1 | 30.2 | 36.3 |
| o-Xylene | 64.0 | 0.0 | 60.0 | 18.7 | 10.7 | 5.6 | 22.3 |
| p- & m-Xylene | 66.5 | 0.0 | 62.3 | 22.6 | 4.7 | 1.6 | 23.1 |
| TNMHC | 42.7 | 0.0 | 41.9 | 6.8 | 3.6 | 2.9 | 8.3 |

[1] Measurement variability combines temporal, sampling, and analytical variabilities.

Notes:
1. A %CV of 0.0 implies negligible variabiility relative to other sources of variability.
2. A value of "---" is given for those on-site analyses where only averages of multiple measurements have been reported.
3. The variabilities were developed from the combined data set for Sections 2/8 and 3/4.
4. The data for methane, carbon dioxide, and oxygen are based on the on-site measurements.

**Table 5-6**
**Possible Feature/Liner/Gas Extraction Well Combinations for Each Section**

| Section 3/4 | Section 2/8 | Section 1/9 | Section 6/7 |
|---|---|---|---|
| Toe/Clay | Toe/Clay | Toe/Soil/No | Toe |
| Toe/Soil | Toe/Soil | Toe/Clay/No | Side |
| Toe/PVC | Toe/PVC | Side/Soil/No | Top |
| Side/Clay | Side/Clay | Side/Clay/No | Active Face |
| Side/Soil | Side/Soil | Top/Soil/No | Cracks |
| Side/PVC | Side/PVC | Top/Soil/Yes | Seeps |
| Top/Soil | Top/Soil | Cracks | |
| Top/PVC | Top/PVC | Seeps | |
| Cracks | | Active Face | |
| Seeps | | | |

# Table 5-7
## Surface Emissions of Select Compounds from Section 1/9

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination and Presence of Landfill Gas Extraction System | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay/No | Toe/Soil/No | Side/Clay/No | Side/Soil/No | Top/Soil/No | Top/Soil/Yes | Cracks | Seeps | Active face |
| Activity Factor (hectares) | | | 9.120 | 20.900 | 10.500 | 45.740 | 68.950 | 19.290 | 0.176 | 0.006 | 1.070 |
| Methane | 6340 | Avg. E.F. | <1.48e-01 | 3.04e-01 | <1.48e-01 | 3.04e-01 | <1.72e-01 | <1.43e-01 | 4.66e-01 | <1.48e-01 | <1.43e-01 |
| | | E.R. (g/sec) | 2.25e+02 | 1.06e+03 | 2.59e+02 | 2.32e+03 | 1.98e+03 | 4.60e+02 | 1.36e+01 | 1.37e-01 | 2.55e+01 |
| Carbon Dioxide | 11400 | Avg. E.F. | 6.36e-01 | 3.37e-01 | 6.36e-01 | 3.37e-01 | 2.12e-01 | 9.30e-01 | 6.29e-01 | 3.62e-02 | 7.30e-01 |
| | | E.R. (g/sec) | 9.67e+02 | 1.18e+03 | 1.11e+03 | 2.57e+03 | 2.43e+03 | 2.99e+03 | 1.84e+01 | 3.36e-02 | 1.30e+02 |
| Hydrogen Sulfide | 0.0304 | Avg. E.F. | 3.66e+00 | 1.40e+00 | 3.66e+00 | 1.40e+00 | 1.30e-01 | 3.37e-01 | 1.95e+00 | 4.26e+00 | 9.52e-01 |
| | | E.R. (g/sec) | 5.57e-03 | 4.89e-03 | 6.41e-03 | 1.07e-02 | 1.49e-03 | 1.08e-03 | 5.71e-05 | 3.96e-06 | 1.70e-04 |
| 1,1,1-Trichloroethane | 0.0041 | Avg. E.F. | 1.97e-02 | 1.86e-01 | 1.97e-02 | 1.86e-01 | 1.50e-02 | 1.17e-01 | 2.87e-01 | 6.75e-02 | 7.90e+00 |
| | | E.R. (g/sec) | 2.99e-05 | 6.46e-04 | 3.44e-05 | 1.41e-03 | 1.72e-04 | 3.75e-04 | 8.40e-06 | 6.27e-08 | 1.41e-03 |
| 1,1-Dichloroethane | 0.172 | Avg. E.F. | 0 | 1.52e+01 | 0 | 1.52e+01 | 0 | 8.68e-01 | 3.03e+01 | 8.00e-03 | 4.49e-01 |
| | | E.R. (g/sec) | 0 | 5.28e-02 | 0 | 1.16e-01 | 0 | 2.79e-03 | 8.87e-04 | 7.43e-09 | 8.01e-05 |
| 1,1-Dichloroethylene | 0.0021 | Avg. E.F. | 0 | 1.60e-01 | 0 | 1.60e-01 | 2.60e-02 | 1.30e-02 | 2.98e-01 | 1.05e-02 | 0 |
| | | E.R. (g/sec) | 0 | 5.56e-04 | 0 | 1.22e-03 | 2.99e-04 | 4.18e-05 | 8.72e-06 | 9.75e-09 | 0 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.0745 | Avg. E.F. | 1.80e+01 | 4.88e-01 | 1.80e+01 | 4.88e-01 | 6.29e-01 | 7.88e-01 | 9.76e-01 | 7.60e-02 | 1.39e+00 |
| | | E.R. (g/sec) | 2.74e-02 | 1.70e-03 | 3.16e-02 | 3.72e-03 | 7.23e-03 | 2.53e-03 | 2.86e-05 | 7.06e-08 | 2.48e-04 |
| Benzene | 0.0095 | Avg. E.F. | 1.70e+00 | 2.89e-01 | 1.70e+00 | 2.89e-01 | 3.00e-02 | 1.03e-01 | 5.28e-01 | 6.45e-02 | 8.00e-03 |
| | | E.R. (g/sec) | 2.58e-03 | 1.00e-03 | 2.97e-03 | 2.20e-03 | 3.45e-04 | 3.32e-04 | 1.55e-05 | 5.99e-08 | 1.43e-06 |
| Ethylbenzene | 0.0739 | Avg. E.F. | 1.71e+01 | 1.27e+00 | 1.71e+01 | 1.27e+00 | 1.62e-01 | 6.16e-01 | 2.48e+00 | 8.40e-02 | 2.82e-01 |
| | | E.R. (g/sec) | 2.59e-02 | 4.43e-03 | 2.98e-02 | 9.70e-03 | 1.86e-03 | 1.98e-03 | 7.25e-05 | 7.80e-08 | 5.02e-05 |

# Table 5-7
# (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination and Presence of Landfill Gas Extraction System | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay/No | Toe/Soil/No | Side/Clay/No | Side/Soil/No | Top/Soil/No | Top/Soil/Yes | Cracks | Seeps | Active face |
| Activity Factor (hectares) | | | 9.120 | 20.900 | 10.500 | 45.740 | 68.950 | 19.290 | 0.176 | 0.006 | 1.070 |
| Isobutane | 0.311 | Avg. E.F. | 1.02e+01 | 2.16e+01 | 1.02e+01 | 2.16e+01 | 1.10e-01 | 1.03e+01 | 4.32e+01 | 0 | 1.15e+01 |
| | | E.R. (g/sec) | 1.54e-02 | 7.52e-02 | 1.78e-02 | 1.65e-01 | 1.26e-03 | 3.32e-02 | 1.26e-03 | 0 | 2.04e-03 |
| Isopentane | 0.379 | Avg. E.F. | 5.74e-01 | 2.97e+01 | 5.74e-01 | 2.97e+01 | 3.02e-01 | 8.92e+00 | 5.94e+01 | 2.45e-02 | 7.14e+01 |
| | | E.R. (g/sec) | 8.72e-04 | 1.03e-01 | 1.00e-03 | 2.26e-01 | 3.47e-03 | 2.87e-02 | 1.74e-03 | 2.28e-08 | 1.27e-02 |
| Methylene Chloride | 0.189 | Avg. E.F. | 4.77e-02 | 1.68e+01 | 4.77e-02 | 1.68e+01 | 1.60e-02 | 7.00e-02 | 3.36e+01 | 1.30e-02 | 5.05e+00 |
| | | E.R. (g/sec) | 7.25e-05 | 5.86e-02 | 8.34e-05 | 1.28e-01 | 1.84e-04 | 2.25e-04 | 9.84e-04 | 1.21e-08 | 9.00e-04 |
| Styrene | 0.0381 | Avg. E.F. | 5.19e+00 | 1.55e+00 | 5.19e+00 | 1.55e+00 | 7.90e-02 | 8.65e-01 | 3.01e+00 | 4.95e-02 | 4.57e-01 |
| | | E.R. (g/sec) | 7.88e-03 | 5.41e-03 | 9.08e-03 | 1.18e-02 | 9.08e-04 | 2.78e-03 | 8.79e-05 | 4.60e-08 | 8.16e-05 |
| Tetrachloroethylene | 0.0643 | Avg. E.F. | 3.17e-02 | 5.60e+00 | 3.17e-02 | 5.60e+00 | 4.40e-02 | 3.44e-01 | 1.11e+01 | 6.60e-02 | 2.74e-01 |
| | | E.R. (g/sec) | 4.81e-05 | 1.95e-02 | 5.54e-05 | 4.27e-02 | 5.06e-04 | 1.11e-03 | 3.25e-04 | 6.13e-08 | 4.89e-05 |
| Toluene | 0.128 | Avg. E.F. | 9.30e-01 | 1.01e+01 | 9.30e-01 | 1.01e+01 | 1.74e-01 | 2.93e+00 | 1.96e+01 | 3.98e-01 | 1.24e+00 |
| | | E.R. (g/sec) | 1.41e-03 | 3.53e-02 | 1.63e-03 | 7.72e-02 | 2.00e-03 | 9.42e-03 | 5.73e-04 | 3.70e-07 | 2.21e-04 |
| Vinyl Chloride | 0.0169 | Avg. E.F. | 0 | 1.48e+00 | 0 | 1.48e+00 | 0 | 1.33e-01 | 2.96e+00 | 0 | 1.90e-02 |
| | | E.R. (g/sec) | 0 | 5.15e-03 | 0 | 1.13e-02 | 0 | 4.27e-04 | 8.65e-05 | 0 | 3.39e-06 |
| c-1,2-Dichloroethylene | 0.0178 | Avg. E.F. | 0 | 1.49e+00 | 0 | 1.49e+00 | 0 | 3.59e-01 | 2.95e+00 | 1.50e-02 | 0 |
| | | E.R. (g/sec) | 0 | 5.18e-03 | 0 | 1.13e-02 | 0 | 1.15e-03 | 8.62e-05 | 1.39e-08 | 0 |
| n-Butane | 0.0615 | Avg. E.F. | 7.35e+00 | 9.81e-01 | 7.35e+00 | 9.81e-01 | 1.10e-01 | 6.53e+00 | 1.96e+00 | 2.25e-02 | 2.41e+01 |
| | | E.R. (g/sec) | 1.12e-02 | 3.42e-03 | 1.29e-02 | 7.48e-03 | 1.26e-03 | 2.10e-02 | 5.74e-05 | 2.09e-08 | 4.29e-03 |

# Table 5-7
## (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination and Presence of Landfill Gas Extraction System | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay/No | Toe/Soil/No | Side/Clay/No | Side/Soil/No | Top/Soil/No | Top/Soil/Yes | Cracks | Seeps | Active face |
| Activity Factor (hectares) | | | 9.120 | 20.900 | 10.500 | 45.740 | 68.950 | 19.290 | 0.176 | 0.006 | 1.070 |
| n-Decane & p-Dichlorobenzene | 0.125 | Avg. E.F. | 1.64e+01 | 3.31e+00 | 1.64e+01 | 3.31e+00 | 2.15e+00 | 2.84e+00 | 6.48e+00 | 1.87e-01 | 9.16e-01 |
| | | E.R. (g/sec) | 2.50e-02 | 1.15e-02 | 2.88e-02 | 2.52e-02 | 2.47e-02 | 9.12e-03 | 1.90e-04 | 1.74e-07 | 1.63e-04 |
| n-Nonane | 0.0816 | Avg. E.F. | 1.68e+01 | 2.09e+00 | 1.68e+01 | 2.09e+00 | 4.80e-02 | 8.78e-01 | 4.18e+00 | 0 | 2.60e-02 |
| | | E.R. (g/sec) | 2.55e-02 | 7.27e-03 | 2.94e-02 | 1.59e-02 | 5.52e-04 | 2.82e-03 | 1.22e-04 | 0 | 4.64e-06 |
| o-Xylene | 0.0341 | Avg. E.F. | 4.67e+00 | 1.24e+00 | 4.67e+00 | 1.24e+00 | 2.84e-01 | 5.19e-01 | 2.41e+00 | 9.70e-02 | 2.93e-01 |
| | | E.R. (g/sec) | 7.10e-03 | 4.32e-03 | 8.17e-03 | 9.45e-03 | 3.26e-03 | 1.67e-03 | 7.06e-05 | 9.01e-08 | 5.23e-05 |
| p/m-Xylene | 0.0789 | Avg. E.F. | 1.43e+01 | 2.45e+00 | 1.43e+01 | 2.45e+00 | 2.04e-01 | 7.43e-01 | 4.76e+00 | 1.22e-01 | 3.58e-01 |
| | | E.R. (g/sec) | 2.18e-02 | 8.52e-03 | 2.51e-02 | 1.87e-02 | 2.34e-03 | 2.39e-03 | 1.39e-04 | 1.13e-07 | 6.38e-05 |
| TNMHC | 5.94 | Avg. E.F. | 9.28e+02 | 2.00e+02 | 9.28e+02 | 2.00e+00 | 2.40e+01 | 1.08e+02 | 3.92e+02 | 1.35e+01 | 2.83e+02 |
| | | E.R. (g/sec) | 1.41e+00 | 6.98e-01 | 1.62e+00 | 1.53e+00 | 2.76e-01 | 3.47e-01 | 1.15e-02 | 1.25e-05 | 5.05e-02 |

*Notes:*
1. Total emission rate = emissions from each feature/cover/landfill gas extraction system combination
2. Avg E.F. = average emission factor in units of ug/m$^2$-min, except for methane and carbon dioxide which are in units of g/m$^2$-min
3. E.R. is emission rate = (activity factor) x (emission factor)
4. Activity factor in units of hectare (1 hectare = 10,000 m$^2$)

# Table 5-8
## Surface Emissions of Select Compounds from Section 2/8

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC |
| Activity Factor | | | 6.05 | 17.77 | 0.76 | 2.26 | 15.64 | 3.80 | 9.07 | 2.70 |
| Methane | 3240 | Avg. E.F. | < 0.136 | < 0.773 | < 0.136 | < 0.136 | < 0.148 | < 0.136 | < 0.143 | < 0.136 |
| | | E.R. (g/sec) | 1.37e+02 | 2.29e+03 | 1.72e+01 | 5.12e+01 | 3.86e+02 | 8.61e+01 | 2.16e+02 | 6.12e+01 |
| Carbon dioxide | 4420 | Avg. E.F. | 0 | 1.44 | 0.0767 | 0 | 0.0137 | 0.0767 | 0.0221 | 0.0767 |
| | | E.R. (g/sec) | 0 | 4.26e+03 | 9.71e+00 | 0 | 3.56e+01 | 4.86e+01 | 3.43e+01 | 3.45e+01 |
| Hydrogen sulfide | 0.00778 | Avg. E.F. | 2.0e-01 | 1.5e+00 | 7.0e-01 | 2.0e-01 | 5.0e-01 | 7.0e-01 | 6.0e-01 | 7.0e-01 |
| | | E.R. (g/sec) | 2.02e-04 | 4.44e-03 | 8.87e-05 | 7.53e-05 | 1.30e-03 | 4.43e-04 | 9.07e-04 | 3.15e-04 |
| 1,1,1-Trichloroethane | 0.00002 | Avg. E.F. | 0 | 0 | 1.2e-02 | 0 | 3.0e-03 | 1.2e-02 | 0 | 1.2e-02 |
| | | E.R. (g/sec) | 0 | 0 | 1.52e-06 | 0 | 7.82e-06 | 7.60e-06 | 0 | 5.40e-06 |
| 1,1-Dichloroethane | 0.00187 | Avg. E.F. | 0 | 6.32e-01 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (g/sec) | 0 | 1.87e-03 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,1-Dichloroethylene | 0.00 | Avg. E.F. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (g/sec) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.0047 | Avg. E.F. | 3.80e-02 | 1.75e-01 | 0 | 3.80e-02 | 1.36e+00 | 0 | 3.72e-01 | 0 |
| | | E.R. (g/sec) | 3.83e-05 | 5.11e-04 | 0 | 1.43e-05 | 3.55e-03 | 0 | 5.62e-04 | 0 |
| Benzene | 0.0090 | Avg. E.F. | 0 | 2.95e+00 | 4.7e-02 | 0 | 3.43e-02 | 4.7e-02 | 4.87e-02 | 4.7e-02 |
| | | E.R. (g/sec) | 0 | 8.74e-03 | 5.95e-06 | 0 | 8.95e-05 | 2.98e-05 | 7.36e-05 | 2.12e-05 |
| Ethylbenzene | 0.163 | Avg. E.F. | 1.28e-01 | 5.49e+01 | 0 | 1.28e-01 | 1.06e-01 | 0 | 1.32e-01 | 0 |
| | | E.R. (g/sec) | 1.29e-04 | 1.62e-01 | 0 | 4.82e-05 | 2.75e-04 | 0 | 2.00e-04 | 0 |

# Table 5-8
# (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC |
| Activity Factor | | | 6.05 | 17.77 | 0.76 | 2.26 | 15.64 | 3.80 | 9.07 | 2.70 |
| Isobutane | 0.126 | Avg. E.F. | 0 | 4.22e+01 | 0 | 0 | 2.01e-01 | 0 | 1.33e-01 | 0 |
| | | E.R. (g/sec) | 0 | 1.25e-01 | 0 | 0 | 5.23e-04 | 0 | 2.01e-04 | 0 |
| Isopentane | 0.0328 | Avg. E.F. | 2.22e-02 | 1.09e+01 | 0 | 2.2e-02 | 1.57e-01 | 0 | 2.27e-02 | 0 |
| | | E.R. (g/sec) | 2.22e-05 | 3.23e-02 | 0 | 8.29e-06 | 4.09e-04 | 0 | 3.43e-05 | 0 |
| Methylene chloride | 0.000911 | Avg. E.F. | 0 | 1.91e-01 | 0 | 0 | 1.33e-01 | 0 | 0 | 0 |
| | | E.R. (g/sec) | 0 | 5.64e-04 | 0 | 0 | 3.47e-04 | 0 | 0 | 0 |
| Styrene | 0.0242 | Avg. E.F. | 0 | 7.84e+00 | 0 | 0 | 2.87e-01 | 0 | 1.41e-01 | 0 |
| | | E.R. (g/sec) | 0 | 2.32e-02 | 0 | 0 | 7.47e-04 | 0 | 2.13e-04 | 0 |
| Tetrachloroethylene | 0.00377 | Avg. E.F. | 0 | 1.10e-02 | 3.0e-02 | 0 | 1.42e+00 | 3.0e-02 | 3.77e-02 | 3.0e-02 |
| | | E.R. (g/sec) | 0 | 3.26e-05 | 3.80e-06 | 0 | 3.70e-03 | 1.90e-05 | 5.69e-05 | 1.35e-05 |
| Toluene | 0.0106 | Avg. E.F. | 5.6e-02 | 3.22e+00 | 5.6e-02 | 5.6e-02 | 2.83e-01 | 5.6e-02 | 1.54e-01 | 5.6e-02 |
| | | E.R. (g/sec) | 5.65e-05 | 9.53e-03 | 7.09e-06 | 2.11e-05 | 7.38e-04 | 3.55e-05 | 2.33e-04 | 2.52e-05 |
| Vinyl Chloride | 0.00 | Avg. E.F. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | E.R. (g/sec) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| c-1,2-Dichloroethylene | 0.00013 | Avg. E.F. | 0 | 3.40e-02 | 0 | 0 | 9.67e-03 | 0 | 4.0e-03 | 0 |
| | | E.R. (g/sec) | 0 | 1.01e-04 | 0 | 0 | 2.52e-05 | 0 | 6.05e-06 | 0 |
| n-Butane | 0.0738 | Avg. E.F. | 8.80e-02 | 2.46e+01 | 0 | 8.80e-02 | 1.13e-01 | 0 | 4.10e-01 | 0 |
| | | E.R. (g/sec) | 8.87e-05 | 7.27e-02 | 0 | 3.31e-05 | 2.95e-04 | 0 | 6.20e-04 | 0 |

# Table 5-8
## (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC |
| Activity Factor | | | 6.05 | 17.77 | 0.76 | 2.26 | 15.64 | 3.80 | 9.07 | 2.70 |
| n-Decane & p-Dichlorobenzene | 0.133 | Avg. E.F. | 8.70e-02 | 4.39e+01 | 4.5e-02 | 8.70e-02 | 9.42e-01 | 4.5e-02 | 4.16e-01 | 4.5e-02 |
| | | E.R. (g/sec) | 8.77e-05 | 1.30e-01 | 5.70e-06 | 3.28e-05 | 2.45e-03 | 2.85e-05 | 6.29e-04 | 2.03e-05 |
| n-Nonane | 0.0769 | Avg. E.F. | 0 | 2.58e+01 | 0 | 0 | 9.97e-02 | 0 | 6.60e-02 | 0 |
| | | E.R. (g/sec) | 0 | 7.65e-02 | 0 | 0 | 2.60e-04 | 0 | 9.98e-05 | 0 |
| o-Xylene | 0.0234 | Avg. E.F. | 0 | 7.74e+00 | 0 | 0 | 1.39e-01 | 0 | 9.90e-02 | 0 |
| | | E.R. (g/sec) | 0 | 2.29e-02 | 0 | 0 | 3.62e-04 | 0 | 1.50e-04 | 0 |
| p/m-Xylene | 0.127 | Avg. E.F. | 9.70e-02 | 4.26e+01 | 3.3e-02 | 9.70e-02 | 1.19e-01 | 3.3e-02 | 1.44e-01 | 3.3e-02 |
| | | E.R. (g/sec) | 9.78e-05 | 1.26e-01 | 4.18e-06 | 3.65e-05 | 3.11e-04 | 2.09e-05 | 2.17e-04 | 1.49e-05 |
| TNMHC | 4.09 | Avg. E.F. | 3.53e+00 | 1.27e+03 | 3.09e+00 | 3.53e+00 | 7.18e+01 | 3.09e+00 | 8.55e+01 | 3.09e+00 |
| | | E.R. (g/sec) | 3.56e-03 | 3.76e+00 | 3.91e-04 | 1.33e-03 | 1.87e-01 | 1.96e-03 | 1.29e-01 | 1.39e-03 |

Notes:
1. Total emission rate = emissions from each feature/cover/landfill gas extraction system combination
2. Avg E.F. = average emission factor in units of ug/m$^2$-min, except for methane and carbon dioxide which are in units of g/m$^2$-min
3. E.R. is emission rate = (activity factor) x (emission factor)
4. Activity factor in units of hectare (1 hectare = 10,000 m$^2$)

# Table 5-9
## Surface Emissions of Select Compounds from Section 3/4

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC | Cracks | Seeps |
| Activity Factor (hectares) | | | 8.25 | 12.69 | 0.8 | 0.57 | 14.17 | 7.36 | 12.93 | 0.1 | 0.05805 | 0.0005 |
| Methane | 6820 | Avg. E.F. | 3.03e+00 | <1.42e-01 | <1.16e-01 | 3.03e+00 | 6.61e-01 | <1.16e-01 | <1.46e-01 | <1.16e-01 | 3.03e+00 | <1.58e-01 |
| | | E.R. (g/sec) | 4.17e+03 | 3.00e+02 | 1.55e+01 | 2.88e+02 | 1.56e+03 | 1.42e+02 | 3.15e+02 | 1.93e+00 | 2.93e+01 | 1.22e-02 |
| Carbon Dioxide | 12000 | Avg. E.F. | 3.54e+00 | 3.88e-01 | 3.72e-02 | 3.54e+00 | 1.51e+00 | 3.72e-02 | 1.09e+00 | 3.72e-02 | 3.54e+00 | 3.28e-02 |
| | | E.R. (g/sec) | 4.86e+03 | 8.21e+02 | 4.96e+00 | 3.36e+02 | 3.57e+03 | 4.56e+01 | 2.35e+03 | 6.20e-01 | 3.42e+01 | 2.54e-03 |
| Hydrogen Sulfide | 0.004 | Avg. E.F. | 5.95e-01 | 9.59e-01 | 3.31e-01 | 5.95e-01 | 6.63e-02 | 3.31e-01 | 1.10e-01 | 3.31e-01 | 5.95e-01 | 5.24e+00 |
| | | E.R. (g/sec) | 8.18e-04 | 2.03e-03 | 4.41e-05 | 5.65e-05 | 1.57e-04 | 4.06e-04 | 2.37e-04 | 5.52e-06 | 5.76e-06 | 4.05e-07 |
| 1,1,1-Trichloroethane | 0.002 | Avg. E.F. | 7.11e-01 | 0 | 4.37e-02 | 7.11e-01 | 2.84e-01 | 4.37e-02 | 4.00e-03 | 4.37e-02 | 7.11e-01 | 9.00e-03 |
| | | E.R. (g/sec) | 9.78e-04 | 0 | 5.82e-06 | 6.75e-05 | 6.72e-04 | 5.36e-05 | 8.62e-06 | 7.28e-07 | 6.88e-06 | 6.96e-10 |
| 1,1-Dichloroethane | 0.002 | Avg. E.F. | 9.05e-01 | 0 | 0 | 9.05e-01 | 1.25e-01 | 0 | 0 | 0 | 9.05e-01 | 0 |
| | | E.R. (g/sec) | 1.24e-03 | 0 | 0 | 8.60e-05 | 2.95e-04 | 0 | 0 | 0 | 8.76e-06 | 0 |
| 1,1-Dichloroethylene | 0.000 | Avg. E.F. | 7.40e-02 | 0 | 0 | 7.40e-02 | 8.03e-02 | 0 | 0 | 0 | 7.40e-02 | 0 |
| | | E.R. (g/sec) | 1.02e-04 | 0 | 0 | 7.03e-06 | 1.90e-04 | 0 | 0 | 0 | 7.16e-07 | 0 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.147 | Avg. E.F. | 5.58e+01 | 8.00e-02 | 3.50e-02 | 5.58e+01 | 2.72e+01 | 3.50e-02 | 1.70e-02 | 3.50e-02 | 5.58e+01 | 4.40e-02 |
| | | E.R. (g/sec) | 7.67e-02 | 1.69e-04 | 4.67e-06 | 5.30e-03 | 6.44e-02 | 4.29e-05 | 3.66e-05 | 5.83e-07 | 5.40e-04 | 3.40e-09 |
| Benzene | 0.009 | Avg. E.F. | 3.17e+00 | 0 | 2.40e-02 | 3.17e+00 | 1.97e+00 | 2.40e-02 | 0 | 2.40e-02 | 3.17e+00 | 5.40e-02 |
| | | E.R. (g/sec) | 4.36e-03 | 0 | 3.20e-06 | 3.02e-04 | 4.64e-03 | 2.94e-05 | 0 | 4.00e-07 | 3.07e-05 | 4.18e-09 |
| Ethylbenzene | 0.082 | Avg. E.F. | 1.37e+01 | 6.60e-02 | 4.43e-02 | 1.37e+01 | 2.60e+01 | 4.43e-02 | 0 | 4.43e-02 | 1.37e+01 | 7.40e-02 |
| | | E.R. (g/sec) | 1.88e-02 | 1.40e-04 | 5.91e-06 | 1.30e-03 | 6.13e-02 | 5.44e-05 | 0 | 7.39e-07 | 1.32e-04 | 5.72e-09 |

# Table 5-9
# (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC | Cracks | Seeps |
| **Activity Factor (hectares)** | | | **8.25** | **12.69** | **0.8** | **0.57** | **14.17** | **7.36** | **12.93** | **0.1** | **0.05805** | **0.0005** |
| Isobutane | 0.090 | Avg. E.F. | 3.17e+01 | 5.50e-02 | 3.59e-01 | 3.17e+01 | 1.77e+01 | 3.59e-01 | 2.46e-01 | 3.59e-01 | 3.17e+01 | 0 |
| | | E.R. (g/sec) | 4.36e-02 | 1.16e-04 | 4.79e-05 | 3.02e-03 | 4.17e-02 | 4.41e-04 | 5.30e-04 | 5.99e-06 | 3.07e-04 | 0 |
| Isopentane | 0.037 | Avg. E.F. | 1.71e+01 | 9.00e-02 | 1.53e+00 | 1.71e+01 | 4.13e+00 | 1.53e+00 | 4.65e-02 | 1.53e+00 | 1.71e+01 | 0 |
| | | E.R. (g/sec) | 2.35e-02 | 1.90e-04 | 2.03e-04 | 1.62e-03 | 9.74e-03 | 1.87e-03 | 1.00e-04 | 2.54e-05 | 1.65e-04 | 0 |
| Methylene Chloride | 0.002 | Avg. E.F. | 9.13e-01 | 2.12e-01 | 2.87e-02 | 9.13e-01 | 6.63e-02 | 2.87e-02 | 0 | 2.87e-02 | 9.13e-01 | 1.20e-02 |
| | | E.R. (g/sec) | 1.26e-03 | 4.48e-04 | 3.82e-06 | 8.67e-05 | 1.57e-04 | 3.52e-05 | 0 | 4.78e-07 | 8.83e-06 | 9.28e-10 |
| Styrene | 0.062 | Avg. E.F. | 3.37e+01 | 0 | 0 | 3.37e+01 | 4.98e+00 | 0 | 0 | 0 | 3.37e+01 | 0 |
| | | E.R. (g/sec) | 4.63e-02 | 0 | 0 | 3.20e-03 | 1.18e-02 | 0 | 0 | 0 | 3.26e-04 | 0 |
| Tetrachloroethylene | 0.002 | Avg. E.F. | 6.14e-01 | 3.10e-02 | 6.00e-02 | 6.14e-01 | 1.96e-01 | 6.00e-02 | 1.35e-02 | 6.00e-02 | 6.14e-01 | 0 |
| | | E.R. (g/sec) | 8.44e-04 | 6.56e-05 | 8.00e-06 | 5.83e-05 | 4.64e-04 | 7.36e-05 | 2.91e-05 | 1.00e-06 | 5.94e-06 | 0 |
| Toluene | 0.114 | Avg. E.F. | 8.19e+00 | 8.70e-02 | 3.17e-01 | 8.19e+00 | 4.29e+01 | 3.17e-01 | 1.05e-01 | 3.17e-01 | 8.19e+00 | 9.70e-02 |
| | | E.R. (g/sec) | 1.13e-02 | 1.84e-04 | 4.22e-05 | 7.78e-04 | 1.01e-01 | 3.88e-04 | 2.26e-04 | 5.28e-06 | 7.92e-05 | 7.50e-09 |
| Vinyl Chloride | 0.001 | Avg. E.F. | 2.14e-01 | 0 | 0 | 2.14e-01 | 3.63e-01 | 0 | 0 | 0 | 2.14e-01 | 0 |
| | | E.R. (g/sec) | 2.94e-04 | 0 | 0 | 2.03e-05 | 8.57e-04 | 0 | 0 | 0 | 2.07e-06 | 0 |
| c-1,2-Dichloroethylene | 0.001 | Avg. E.F. | 9.40e-02 | 0 | 0 | 9.40e-02 | 2.18e-01 | 0 | 0 | 0 | 9.40e-02 | 0 |
| | | E.R. (g/sec) | 1.29e-04 | 0 | 0 | 8.93e-06 | 5.15e-04 | 0 | 0 | 0 | 9.09e-07 | 0 |
| n-Butane | 0.075 | Avg. E.F. | 3.24e+01 | 1.82e-01 | 4.73e-02 | 3.24e+01 | 1.08e+01 | 4.73e-02 | 3.22e-01 | 4.73e-02 | 3.24e+01 | 9.54e-01 |
| | | E.R. (g/sec) | 4.46e-02 | 3.85e-04 | 6.31e-06 | 3.08e-03 | 2.55e-02 | 5.81e-05 | 6.93e-04 | 7.89e-07 | 3.14e-04 | 7.38e-08 |

# Table 5-9
## (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature/Cover Material Combination | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Toe/Clay | Toe/Soil | Toe/PVC | Side/Clay | Side/Soil | Side/PVC | Top/Soil | Top/PVC | Cracks | Seeps |
| Activity Factor (hectares) | | | 8.25 | 12.69 | 0.8 | 0.57 | 14.17 | 7.36 | 12.93 | 0.1 | 0.05805 | 0.0005 |
| n-Decane & p-Dichlorobenzene | 0.219 | Avg. E.F. | 4.80e+01 | 3.18e-01 | 3.26e-01 | 4.80e+01 | 6.22e+01 | 3.26e-01 | 1.36e-01 | 3.26e-01 | 4.80e+01 | 1.54e-01 |
| | | E.R. (g/sec) | 6.59e-02 | 6.73e-04 | 4.35e-05 | 4.56e-03 | 1.47e-01 | 4.00e-04 | 2.93e-04 | 5.43e-06 | 4.64e-04 | 1.19e-08 |
| n-Nonane | 0.041 | Avg. E.F. | 7.57e+00 | 4.00e-02 | 0 | 7.57e+00 | 1.25e+01 | 0 | 0 | 0 | 7.57e+00 | 0 |
| | | E.R. (g/sec) | 1.04e-02 | 8.46e-05 | 0 | 7.19e-04 | 2.94e-02 | 0 | 0 | 0 | 7.33e-05 | 0 |
| o-Xylene | 0.052 | Avg. E.F. | 1.40e+01 | 2.90e-02 | 2.60e-02 | 1.40e+01 | 1.33e+01 | 2.60e-02 | 0 | 2.60e-02 | 1.40e+01 | 3.90e-02 |
| | | E.R. (g/sec) | 1.92e-02 | 6.13e-05 | 3.47e-06 | 1.33e-03 | 3.14e-02 | 3.19e-05 | 0 | 4.33e-07 | 1.35e-04 | 3.02e-09 |
| p/m-Xylene | 0.080 | Avg. E.F. | 9.97e+00 | 6.60e-02 | 6.60e-02 | 9.97e+00 | 2.76e+01 | 6.60e-02 | 1.95e-02 | 6.60e-02 | 9.97e+00 | 7.40e-02 |
| | | E.R. (g/sec) | 1.37e-02 | 1.40e-04 | 8.80e-06 | 9.47e-04 | 6.52e-02 | 8.10e-05 | 4.20e-05 | 1.10e-06 | 9.64e-05 | 5.72e-09 |
| TNMHC | 7.530 | Avg. E.F. | 3.34e+03 | 6.78e+00 | 5.74e+00 | 3.34e+03 | 1.08e+03 | 5.74e+00 | 5.68e+00 | 5.74e+00 | 3.34e+03 | 1.80e+01 |
| | | E.R. (g/sec) | 4.60e+00 | 1.43e-02 | 7.66e-04 | 3.17e-01 | 2.55e+00 | 7.04e-03 | 1.22e-02 | 9.57e-05 | 3.23e-02 | 1.39e-06 |

NOTES:
1. Total emission rate = emissions from each feature/cover combination
2. Avg E.F. = average emission factor in ug/$m^2$-min, except for methane and carbon dioxide, which are in g/$m^2$-min.
3. E.R. is emission rate = (activity factor)*(emission factor)
4. Activity factor in units of hectare (1 hectare = 10,000$m^2$)

# Table 5-10
## Surface Emissions of Select Compounds from Section 6/7

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Active Face | Side | Toe | Top | Cracks | Seeps |
| Activity Factors (hectares) | | | 2.28 | 20.31 | 13.33 | 39.52 | 0.0754 | 0.00372 |
| Methane | 4500 | Avg. E.F. | <1.43e-01 | <1.25e-01 | 1.69e-01 | 2.39e-01 | 1.65e+02 | 4.99e+00 |
| | | E.R. (g/sec) | 5.43e+01 | 4.23e+02 | 3.75e+02 | 1.57e+03 | 2.07e+03 | 3.09e+00 |
| Carbon Dioxide | 9920 | Avg. E.F. | 7.30e-01 | 7.25e-01 | 2.66e-01 | 4.22e-01 | 3.04e+02 | 8.19e+00 |
| | | E.R. (g/sec) | 2.77e+02 | 2.45e+03 | 5.92e+02 | 2.78e+03 | 3.82e+03 | 5.07e+00 |
| Hydrogen Sulfide | 0.259 | Avg. E.F. | 9.52e-01 | 3.42e+00 | 8.56e+01 | 3.30e+00 | 2.60e+03 | 3.27e+03 |
| | | E.R. (g/sec) | 3.62e-04 | 1.16e-02 | 1.90e-01 | 2.17e-02 | 3.27e-02 | 2.03e-03 |
| 1,1,1-Trichloroethane | 0.036 | Avg. E.F. | 7.90e+00 | 3.62e+00 | 4.05e-02 | 2.85e+00 | 1.32e+02 | 5.80e+00 |
| | | E.R. (g/sec) | 3.00e-03 | 1.23e-02 | 9.00e-05 | 1.88e-02 | 1.66e-03 | 3.59e-06 |
| 1,1-Dichloroethane | 0.033 | Avg. E.F. | 4.49e-01 | 3.43e+00 | 0 | 2.85e+00 | 1.68e+02 | 3.26e+01 |
| | | E.R. (g/sec) | 1.71e-04 | 1.16e-02 | 0 | 1.88e-02 | 2.11e-03 | 2.02e-05 |
| 1,1-Dichloroethylene | 0.002 | Avg. E.F. | 0 | 9.19e-02 | 0 | 1.78e-01 | 4.11e+01 | 0 |
| | | E.R. (g/sec) | 0 | 3.11e-04 | 0 | 1.17e-03 | 5.16e-04 | 0 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 0.206 | Avg. E.F. | 1.39e+00 | 7.26e-01 | 2.54e+00 | 1.09e+00 | 1.51e+04 | 1.96e+02 |
| | | E.R. (g/sec) | 5.28e-04 | 2.46e-03 | 5.63e-03 | 7.17e-03 | 1.90e-01 | 1.21e-04 |
| Benzene | 0.012 | Avg. E.F. | 8.00e-03 | 3.58e-01 | 2.45e-01 | 3.37e-01 | 6.11e+02 | 1.43e+01 |
| | | E.R. (g/sec) | 3.04e-06 | 1.21e-03 | 5.44e-04 | 2.22e-03 | 7.68e-03 | 8.84e-06 |
| Ethylbenzene | 0.196 | Avg. E.F. | 2.82e-01 | 1.47e+00 | 3.09e+00 | 2.07e+00 | 1.35e+04 | 2.40e+02 |
| | | E.R. (g/sec) | 1.07e-04 | 4.96e-03 | 6.87e-03 | 1.36e-02 | 1.70e-01 | 1.49e-04 |
| Isobutane | 0.463 | Avg. E.F. | 1.15e+01 | 8.85e+01 | 7.68e-01 | 8.39e+00 | 8.08e+03 | 2.89e+02 |
| | | E.R. (g/sec) | 4.36e-03 | 2.99e-01 | 1.71e-03 | 5.53e-02 | 1.02e-01 | 1.79e-04 |
| Isopentane | 1.04 | Avg. E.F. | 7.14e+01 | 2.38e+02 | 3.71e+00 | 2.86e+01 | 4.91e+02 | 9.04e+01 |
| | | E.R. (g/sec) | 2.71e-02 | 8.05e-01 | 8.23e-03 | 1.88e-01 | 6.17e-03 | 5.60e-05 |
| Methylene Chloride | 0.098 | Avg. E.F. | 5.05e+00 | 9.09e+00 | 7.50e-03 | 9.72e+00 | 8.75e+01 | 1.30e-02 |
| | | E.R. (g/sec) | 1.92e-03 | 3.08e-02 | 1.67e-05 | 6.40e-02 | 1.10e-03 | 8.05e-09 |

# Table 5-10
# (Continued)

| Compound | Total Emission Rate (g/sec) | Factor | Emissions by Feature: Active Face | Side | Toe | Top | Cracks | Seeps |
|---|---|---|---|---|---|---|---|---|
| Activity Factor (hectares) | | | 2.28 | 20.31 | 13.33 | 39.52 | 0.0754 | 0.00372 |
| Styrene | 0.060 | Avg. E.F. | 4.57E-01 | 1.25E+00 | 4.28E-01 | 1.85E+00 | 3.34E+03 | 1.68E+02 |
| | | E.R. (g/sec) | 1.74E-04 | 4.22E-03 | 9.50E-04 | 1.22E-02 | 4.19E-02 | 1.04E-04 |
| Tetrachloroethylene | 0.027 | Avg. E.F. | 2.74e-01 | 1.37e+00 | 8.15e-02 | 2.15e+00 | 6.27e+02 | 1.02e+01 |
| | | E.R. (g/sec) | 1.04e-04 | 4.63e-03 | 1.81e-04 | 1.42e-02 | 7.88e-03 | 6.30e-06 |
| Toluene | 0.348 | Avg. E.F. | 1.24e+00 | 1.42e+01 | 1.36e+01 | 1.32e+01 | 1.45e+04 | 9.08e+02 |
| | | E.R. (g/sec) | 4.70e-04 | 4.80e-02 | 3.02e-02 | 8.69e-02 | 1.82e-01 | 5.62e-04 |
| Vinyl Chloride | 0.019 | Avg. E.F. | 1.90e-02 | 1.86e+00 | 2.56e-01 | 2.45e-01 | 8.39e+02 | 4.35e+01 |
| | | E.R. (g/sec) | 7.22e-06 | 6.30e-03 | 5.69e-04 | 1.62e-03 | 1.05e-02 | 2.70e-05 |
| c-1,2-Dichloroethylene | 0.012 | Avg. E.F. | 0 | 5.36e-01 | 0 | 8.00e-01 | 3.54e+02 | 1.75e+01 |
| | | E.R. (g/sec) | 0 | 1.81e-03 | 0 | 5.27e-03 | 4.45e-03 | 1.08e-05 |
| n-Butane | 0.318 | Avg. E.F. | 2.41e+01 | 7.04e+01 | 1.21e+00 | 4.80e+00 | 2.90e+03 | 1.26e+02 |
| | | E.R. (g/sec) | 9.14e-03 | 2.38e-01 | 2.69e-03 | 3.16e-02 | 3.65e-02 | 7.78e-05 |
| n-Decane & p-Dichlorobenzene | 0.773 | Avg. E.F. | 9.16e-01 | 2.38e+00 | 6.44e+00 | 3.76e+00 | 5.77e+04 | 8.20e+02 |
| | | E.R. (g/sec) | 3.48e-04 | 8.04e-03 | 1.43e-02 | 2.48e-02 | 7.25e-01 | 5.08e-04 |
| n-Nonane | 0.200 | Avg. E.F. | 2.60e-02 | 7.76e-01 | 1.64e+00 | 2.88e+00 | 1.39e+04 | 3.06e+02 |
| | | E.R. (g/sec) | 9.88e-06 | 2.63e-03 | 3.64e-03 | 1.90e-02 | 1.75e-01 | 1.89e-04 |
| o-Xylene | 0.095 | Avg. E.F. | 2.93e-01 | 9.37e-01 | 7.78e-01 | 1.35e+00 | 6.48e+03 | 1.14e+02 |
| | | E.R. (g/sec) | 1.11e-04 | 3.17e-03 | 1.73e-03 | 8.92e-03 | 8.14e-02 | 7.07e-05 |
| p/m-Xylene | 0.220 | Avg. E.F. | 3.58e-01 | 1.70e+00 | 2.05e+00 | 3.00e+00 | 1.51e+04 | 3.18e+02 |
| | | E.R. (g/sec) | 1.36e-04 | 5.74e-03 | 4.55e-03 | 1.98e-02 | 1.89e-01 | 1.97e-04 |
| TNMHC | 11.9 | Avg. E.F. | 2.83e+02 | 7.39e+02 | 1.23e+02 | 2.90e+02 | 5.66e+05 | 1.64e+04 |
| | | E.R. (g/sec) | 1.08e-01 | 2.50e+00 | 2.73e-01 | 1.91e+00 | 7.11e+00 | 1.02e-02 |

NOTES: 1. Total emission rate = emissions from each feature
2. Avg E.F. = average emission factor in ug/m$^2$-min, except for methane and carbon dioxide, which are in g/m$^2$-min.
3. E.R. is emission rate = (activity factor)*(emission factor)
4. Activity factor in units of hectare (1 hectare = 10,000 m$^2$)

# Table 5-11
# Summary of Measured Emission Rates from Landfill Surface

| Compound | Emission Rate (g/sec) | | | | Landfill Total |
|---|---|---|---|---|---|
| | Section 1/9 | Section 2/8 | Section 3/4 | Section 6/7 | |
| Methane | 6.34e+03 | 3.24e+03 | 6.82e+03 | 4.50e+03 | 2.13e+04 |
| Carbon Dioxide | 1.14e+04 | 4.42e+03 | 1.20e+04 | 9.92e+03 | 3.77e+04 |
| Hydrogen Sulfide | 3.04e-02 | 7.78e-03 | 4.00e-03 | 2.59e-01 | 3.01e-01 |
| 1,1,1-Trichloroethane | 4.09e-03 | 2.23e-05 | 2.00e-03 | 3.58e-02 | 4.19e-02 |
| 1,1-Dichloroethane | 1.72e-01 | 1.87e-03 | 1.63e-03 | 3.27e-02 | 2.08e-01 |
| 1,1-Dichloroethylene | 2.12e-03 | 0 | 0 | 2.00e-03 | 4.12e-03 |
| 1,2,4-Trimethylbenzene | 7.45e-02 | 4.88e-03 | 1.47e-01 | 2.06e-01 | 4.33e-01 |
| Benzene | 9.45e-03 | 9.00e-03 | 9.37e-03 | 1.17e-02 | 3.96e-02 |
| Ethylbenzene | 7.39e-02 | 1.63e-01 | 8.17e-02 | 1.96e-01 | 5.14e-01 |
| Isobutane | 3.11e-01 | 1.26e-01 | 8.98e-02 | 4.63e-01 | 9.90e-01 |
| Isopentane | 3.79e-01 | 3.28e-02 | 3.74e-02 | 1.04e+00 | 1.49e+00 |
| Methylene Chloride | 1.89e-01 | 9.11e-04 | 2.00e-03 | 9.78e-02 | 2.90e-01 |
| Styrene | 3.81e-02 | 2.42e-02 | 6.16e-02 | 5.96e-02 | 1.83e-01 |
| Tetrachloroethylene | 6.43e-02 | 3.77e-03 | 1.55e-03 | 2.70e-02 | 9.66e-02 |
| Toluene | 1.28e-01 | 1.06e-02 | 1.14e-01 | 3.48e-01 | 6.01e-01 |
| Vinyl Chloride | 1.69e-02 | 0 | 1.17e-03 | 1.91e-02 | 3.72e-02 |
| c-1,2-Dichloroethylene | 1.78e-02 | 1.32e-04 | 6.54e-04 | 1.15e-02 | 3.01e-02 |
| n-Butane | 6.15e-02 | 7.38e-02 | 7.46e-02 | 3.18e-01 | 5.28e-01 |
| n-Decane & p-Dichlorobenzene | 1.25e-01 | 1.33e-01 | 2.19e-01 | 7.73e-01 | 1.25e+00 |
| n-Nonane | 8.16e-02 | 7.69e-02 | 4.07e-02 | 2.00e-01 | 3.99e-01 |
| o-Xylene | 3.41e-02 | 2.34e-02 | 5.22e-02 | 9.54e-02 | 2.05e-01 |
| p/m-Xylene | 7.89e-02 | 1.27e-01 | 8.02e-02 | 2.20e-01 | 5.06e-01 |
| TNMHC | 5.94e+00 | 4.09e+00 | 7.53e+00 | 1.19e+01 | 2.95e+01 |

## Table 5-12
## Variability in Flux Chamber Concentration Measurements from Section 6/7

| Analyte | Sources of Variability based on Concentration Measurements (%CV) | | | | | |
|---|---|---|---|---|---|---|
| | Total | Spatial | Measurement[a] | Temporal | Sampling | Analys |
| Methane | 92.3 | 82.4 | 41.5 | 40.8 | 0.0 | 7.8 |
| Carbon Dioxide | 169.2 | 155.9 | 65.7 | 64.4 | 11.5 | 5.8 |
| Oxygen | 153 | 150.9 | 25.2 | 20.2 | 13.7 | 6.0 |
| Hydrogen Sulfide | 245.6 | 217.7 | 113.6 | 113.6 | 0.0 | 0.0 |
| 1,1,1-Trichloroethane | 186.1 | 172.0 | 71.0 | 70.5 | 8.0 | 3.8 |
| 1,1-Dichloroethane | 174.0 | 137.6 | 106.6 | 104.7 | 0.0 | 20.0 |
| 1,1-Dichloroethylene | 248.8 | 237.2 | 74.9 | 0.0 | 0.0 | 74.9 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 231.7 | 224.3 | 58.0 | 57.4 | 2.7 | 8.2 |
| Benzene | 163.9 | 121.2 | 110.4 | 110.2 | 2.7 | 5.1 |
| Ethylbenzene | 199.0 | 182.9 | 78.3 | 77.8 | 5.4 | 6.0 |
| Isobutane | 195.4 | 179.3 | 77.8 | 77.7 | 1.3 | 3.8 |
| Isopentane | 501.3 | 500.6 | 26.4 | 26.2 | 2.0 | 2.3 |
| Methylene Chloride | 199.6 | 192.9 | 51.4 | 46.5 | 0.0 | 21.7 |
| Nitrogen | 151.8 | 149.9 | 24.5 | 18.4 | 12.0 | 10.8 |
| Styrene | 168.7 | 126.2 | 112.0 | 111.2 | 10.4 | 7.8 |
| TNMHC | 179.0 | 154.9 | 89.7 | 89.2 | 6.3 | 6.3 |
| Tetrachloroethylene | 273.5 | 154.0 | 226.0 | 225.8 | 7.2 | 6.0 |
| Toluene | 189.2 | 152.2 | 112.4 | 112.1 | 6.0 | 6.2 |
| Vinyl Chloride | 139.8 | 133.5 | 41.5 | 30.8 | 23.6 | 14.8 |
| c-1,2-Dichloroethylene | 198.9 | 179.9 | 84.8 | 84.4 | 0.0 | 8.6 |
| n-Butane | 225.8 | 200.7 | 103.6 | 103.4 | 4.2 | 3.9 |
| n-Decane & p-Dichlorobenzene | 235.3 | 222.2 | 77.3 | 76.4 | 8.9 | 8.1 |
| n-Nonane | 168.4 | 145.3 | 85.0 | 84.3 | 8.0 | 7.5 |
| o-Xylene | 201.4 | 189.5 | 68.3 | 67.2 | 11.1 | 5.8 |
| p/m-Xylene | 182.3 | 163.1 | 81.2 | 80.7 | 0.0 | 9.2 |

[a]Measurement variability includes termporal, sampling, and analytical variabilities.

Notes:
1. A %CV of 0.0 implies negligible variability relative to other sources of variability.
2. The variabilities were developed from flux chamber concentration data from Section 6/7.
3. Variability estimates are based on only those measurements that were above the analytical detection limit.

# Table 5-13
## Landfill Gas Emissions to the Gas Collection System

| Compound Name | Emissions (g/sec) | | Total Gas Phase Emissions (g/sec) | Total Liquid Phase Emissions (g/sec) | Total Emissions (g/sec) |
|---|---|---|---|---|---|
| | North Header | South Header | | | |
| TNMHC | 2.66e+00 | 5.35e+00 | 8.01e+00 | 0 | 8.01e+00 |
| Toluene | 8.29e-02 | 2.11e-01 | 2.94e-01 | 3.66e-05 | 2.94e-01 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 4.99e-02 | 8.37e-02 | 1.34e-01 | 0 | 1.34e-01 |
| p-Xylene + m-Xylene | 4.09e-02 | 9.75e-02 | 1.38e-01 | 1.19e-05 | 1.38e-01 |
| n-Nonane | 2.95e-02 | 7.05e-02 | 1.00e-01 | 0 | 1.00e-01 |
| Ethylbenzene | 3.44e-02 | 7.20e-02 | 1.06e-01 | 1.30e-06 | 1.06e-01 |
| Benzyl Chloride & m-Dichlorobenzene | 1.96e-02 | 3.42e-02 | 5.38e-02 | 0 | 5.38e-02 |
| o-Xylene | 1.54e-02 | 3.45e-02 | 4.99e-02 | 1.03e-06 | 4.99e-02 |
| Styrene | 1.23e-02 | 3.47e-02 | 4.70e-02 | 3.64e-07 | 4.70e-02 |
| Chlorobenzene | 8.01e-03 | 2.07e-02 | 2.87e-02 | 0 | 2.87e-02 |
| Benzene | 4.74e-03 | 1.12e-02 | 1.59e-02 | 2.62e-07 | 1.59e-02 |
| c-1,2-Dichloroethylene | 3.55e-03 | 8.47e-03 | 1.20e-02 | 3.15e-07 | 1.20e-02 |
| Methylene Chloride | 4.16e-03 | 4.98e-03 | 9.14e-03 | 3.97e-05 | 9.14e-03 |
| 1,1-Dichloroethane | 1.18e-03 | 7.92e-03 | 9.10e-03 | 0 | 9.10e-03 |
| Trichloroethene | 1.85e-03 | 5.27e-03 | 7.12e-03 | 0 | 7.12e-03 |
| 1,1,1-Trichloroethane | 2.27e-03 | 2.75e-03 | 5.02e-03 | 0 | 5.02e-03 |
| Vinyl Chloride | 8.99e-04 | 2.98e-03 | 3.88e-03 | 0 | 3.88e-03 |
| 1,1-Dichloroethylene | 2.40e-04 | 7.76e-05 | 3.18e-04 | 0 | 3.18e-04 |
| 1,1,2,2-Tetrachloroethane | 2.86e-04 | 2.80e-04 | 5.66e-04 | 0 | 5.66e-04 |
| 1,2,4 Trichlorobenzene | 1.75e-02 | 1.82e-02 | 3.57e-02 | 0 | 3.57e-02 |

**Table 5-14**
**Comparison of Field Measurements of Flow Rate with Gas Plant Data**

| Date | Gas Flow Rates Provided by Gas Plant | | | On-Site Measurements SCMM[3,4] |
|---|---|---|---|---|
| | MCFD[1] | SCFM[2] | SCMM[3] | |
| 7/03/95 | 8.494 | 5,900 | 167 | NA[5] |
| 7/05/95 | 8.418 | 5,840 | 165 | 295 |
| 7/07/95 | 8.304 | 5,770 | 165 | 301 |
| 7/08/95 | 8.169 | 5,670 | 160 | 326 |
| 7/10/95 | 8.263 | 5,740 | 162 | 306 |
| 7/11/95 | 8.157 | 5,660 | 160 | 282 |
| 7/12/95 | 8.058 | 5,600 | 158 | 263 |
| 7/13/95 | 7.958 | 5,530 | 156 | 279 |

[1] Million standard cubic feet per day
[2] Standard cubic feet per minute
[3] Standard cubic meters per minute
[4] Flows assume a duct diameter of 18 inches and moisture content equal to saturation at measured duct temperature.
[5] Invalid value for one of the headers.

# Table 5-15
## Average Landfill Gas Composition (ppm)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| Methane | 53.39% | 55.63% | 42.11% | 54.43% | 54.51% |
| Carbon Dioxide | 37.68% | 37.14% | 29.74% | 39.51% | 37.36% |
| Oxygen | 4.12% | 0.99% | 5.35% | 1.84% | 2.14% |
| TNMHC | 434 | 438 | 272 | 448 | 445 |
| Ethane | 217 | 223 | 195 | 231 | 207 |
| Propane | 15.9 | 13.0 | 8.34 | 16.4 | 16.8 |
| Dichlorodifluoromethane | 1.52 | 1.27 | 0.64 | 2.15 | 1.05 |
| Isobutane | 9.08 | 8.24 | 3.21 | 10.5 | 8.78 |
| Acetaldehyde | ND | ND | ND | ND | ND |
| Vinyl Chloride | 1.97 | 0.27 | 0.21 | 2.57 | 1.72 |
| Isobutene + 1-Butene | 1.15 | 0.92 | 1.56 | 0.94 | 1.28 |
| 1,3-Butadiene | ND | 0.44 | ND | ND | ND |
| n-Butane | 4.02 | 3.80 | 2.05 | 4.34 | 4.06 |
| Methanol (+) | 0.14 | ND | ND | ND | 0.14 |
| Bromomethane | 0.30 | ND | 0.17 | ND | 0.43 |
| t-2-Butene | 0.24 | 0.12 | 0.10 | 0.17 | 0.33 |
| Neopentane | 0.13 | 0.12 | ND | 0.12 | 0.13 |
| c-2-Butene | 0.13 | 0.13 | ND | 0.14 | 0.15 |
| Chloroethane | 0.30 | 0.13 | 0.15 | 0.44 | 0.19 |
| Vinyl Bromide | ND | ND | ND | ND | ND |
| 3-Methyl-1-Butene | 0.15 | 0.13 | 0.16 | 0.13 | 0.16 |
| Isopentane | 2.06 | 3.76 | 0.15 | 3.98 | 0.51 |
| Acetone (+) | 2.25 | 6.09 | 0.19 | 4.14 | 0.74 |
| Trichlorofluoromethane | 0.30 | 0.69 | 0.06 | 0.50 | 0.16 |
| 1-Pentene | 0.16 | 0.16 | ND | 0.15 | 0.14 |
| 2-Methyl-1-Butene | 0.40 | 0.22 | 0.25 | 0.48 | 0.33 |
| Acrylonitrile | ND | ND | ND | ND | ND |
| n-Pentane | 0.87 | 0.97 | 0.23 | 1.44 | 0.42 |
| Isoprene | 0.17 | 0.17 | ND | 0.17 | 0.18 |

# Table 5-15
# (Continued)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| t-2-Pentene | 0.39 | 2.37 | 0.11 | 0.47 | 0.34 |
| 1,1-Dichloroethylene | 1.06 | 1.27 | ND | 0.88 | 1.14 |
| c-2-Pentene | 0.18 | 0.14 | ND | 0.24 | 0.14 |
| Methylene Chloride | 0.90 | 0.55 | ND | 1.81 | 0.14 |
| 2-Methyl-2-Butene | 0.37 | 0.29 | 0.21 | 0.53 | 0.23 |
| Neohexane | 0.16 | 0.17 | 0.11 | 0.19 | 0.16 |
| Cyclopentene | 0.13 | ND | 0.24 | 0.16 | 0.12 |
| t-1,2-Dichloroethylene | 0.11 | ND | ND | 0.11 | 0.11 |
| 4-Methyl-1-Pentene | 0.12 | ND | ND | 0.13 | 0.12 |
| 1,1-Dichloroethane | 0.59 | 0.34 | 0.02 | 1.06 | 0.23 |
| Cyclopentane | 0.35 | 0.24 | ND | 0.55 | 0.18 |
| 1-Propanol | ND | ND | ND | ND | ND |
| 2,3-Dimethylbutane | 0.13 | ND | ND | ND | 0.12 |
| Methyl t-Butylether | 0.99 | ND | ND | 1.89 | 0.25 |
| c-4-Methyl-2-Pentene | 0.14 | ND | 0.11 | ND | 0.13 |
| Isohexane | 0.31 | 0.25 | 0.15 | 0.39 | 0.25 |
| Butyraldehyde | 0.13 | ND | ND | ND | 0.12 |
| t-4-Methyl-2-Pentene | ND | ND | ND | ND | ND |
| 2-Butanone | 0.20 | ND | ND | ND | 0.30 |
| 3-Methylpentane | 0.56 | 2.03 | 0.14 | 0.99 | 0.21 |
| 1-Hexene | 0.32 | 0.17 | ND | 0.51 | 0.19 |
| 2-Methyl-1-Pentene | 0.16 | ND | ND | ND | 0.20 |
| c-1,2-Dichloroethylene | 1.10 | 0.57 | 0.12 | 1.90 | 0.48 |
| 2-Ethyl-1-Butene | 0.14 | ND | ND | 0.11 | 0.13 |
| n-Hexane | 1.70 | 0.92 | 0.28 | 3.04 | 0.62 |
| Chloroform | ND | ND | ND | ND | ND |
| c-3-Hexene | 0.15 | ND | ND | 0.17 | 0.13 |
| t-2-Hexene | 0.12 | 0.24 | ND | 0.13 | 0.14 |
| 2-Methyl-2-Pentene | 0.31 | 0.12 | 0.06 | 0.31 | 0.37 |
| c-2-Hexene | 0.16 | ND | ND | 0.25 | ND |

# Table 5-15
# (Continued)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| c-3-Methyl-2-Pentene | 0.11 | ND | ND | ND | 0.12 |
| Methylcyclopentane | 0.43 | 0.23 | 0.13 | 0.56 | 0.34 |
| 1,2-Dichloroethane | 0.19 | ND | ND | 0.14 | ND |
| 2,4-Dimethylpentane | 0.18 | 0.12 | ND | 0.16 | 0.19 |
| 1,1,1-Trichloroethane | 0.13 | 0.19 | ND | 0.19 | 0.08 |
| Methylcyclopentene | ND | ND | ND | ND | ND |
| Benzene | 0.53 | 0.93 | 0.90 | 0.50 | 0.50 |
| Carbon Tetrachloride | 0.18 | ND | 0.09 | ND | ND |
| 1-Butanol | 0.30 | ND | ND | 0.20 | 0.41 |
| Cyclohexane | 0.76 | 0.45 | 0.21 | 1.13 | 0.49 |
| Isoheptane + 2,3-Dimethylpentane | 0.84 | 0.46 | 0.26 | 1.15 | 0.63 |
| Cyclohexene | 0.14 | ND | ND | 0.16 | ND |
| 3-Methylhexane | 0.56 | 0.37 | 0.17 | 0.82 | 0.38 |
| 1,2-Dichloropropane | 0.10 | ND | ND | ND | 0.11 |
| 1,4-Dioxane | 0.16 | ND | ND | 0.15 | 0.15 |
| Trichloroethylene | ND | ND | ND | ND | ND |
| 1-Heptene | 0.13 | 0.14 | ND | 0.13 | 0.13 |
| 2,2,4-Trimethylpentane | 0.58 | 0.30 | 0.13 | 0.82 | 0.42 |
| n-Heptane | 0.91 | 0.67 | 0.43 | 1.18 | 0.72 |
| t-3-Heptene | 0.18 | 0.19 | 0.18 | 0.13 | 0.24 |
| c-3-Heptene | 0.27 | ND | ND | 0.31 | 0.22 |
| t-2-Heptene | 0.14 | 0.15 | 0.08 | 0.20 | 0.13 |
| 2,4,4-Trimethyl-1-Pentene | 0.12 | ND | ND | 0.12 | 0.14 |
| c-1,3-Dichloropropene | 0.33 | ND | ND | 0.36 | 0.33 |
| Methylcyclohexane | 0.70 | 0.52 | 0.27 | 0.93 | 0.56 |
| Methylisobutylketone | 0.14 | 0.13 | ND | 0.16 | 0.12 |
| 2,4-4-Trimethyl-2-Pentene | ND | ND | ND | ND | ND |
| 2,5-Dimethylhexane | 0.15 | 0.18 | ND | 0.19 | 0.13 |
| 2,2,3-Trimethylpentane | 0.16 | 0.16 | ND | 0.21 | 0.14 |
| t-1,3-Dichloropropene | 0.07 | ND | ND | 0.06 | 0.07 |

# Table 5-15
## (Continued)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| 1,1,2-Trichloroethane | ND | ND | ND | ND | ND |
| 2,3,4-Trimethylpentane | 0.34 | 0.12 | 0.10 | 0.55 | 0.18 |
| Toluene | 19.9 | 14.6 | 1.56 | 27.0 | 16.1 |
| 1-Methylcyclohexene | 0.17 | 0.19 | ND | 0.18 | 0.13 |
| 3,5,5-Trimethylhexene | 0.15 | ND | 0.14 | 0.14 | 0.17 |
| Dibromochloromethane | ND | ND | ND | ND | ND |
| 3-Methylheptane | 0.43 | 0.23 | 0.18 | 0.52 | 0.39 |
| Hexanal | 0.75 | 0.37 | 0.24 | 0.89 | 0.71 |
| 1,2-Dibromoethane | 0.14 | ND | ND | ND | 0.16 |
| 2,2,5-Trimethylhexane | 0.22 | 0.29 | 0.11 | 0.23 | 0.23 |
| 1-Octene | 0.37 | 0.24 | 0.17 | 0.43 | 0.35 |
| n-Octane | 1.63 | 0.99 | 0.49 | 2.07 | 1.40 |
| Tetrachloroethylene | 0.73 | 0.57 | 0.17 | 1.27 | 0.32 |
| c-2-Octene | 0.16 | ND | 0.09 | 0.16 | 0.21 |
| Chlorobenzene | 2.08 | 1.15 | 1.30 | 2.12 | 2.18 |
| Ethylbenzene | 7.09 | 4.71 | 4.22 | 7.07 | 7.66 |
| p-Xylene + m-Xylene | 10.4 | 5.97 | 4.87 | 11.4 | 10.5 |
| Bromoform | ND | ND | ND | ND | ND |
| Styrene | 2.46 | 2.02 | 0.85 | 2.94 | 2.28 |
| Heptanal | 0.22 | ND | 0.17 | 0.21 | 0.22 |
| 1,1,2,2-Tetrachloroethane | 0.09 | 0.03 | 0.09 | 0.08 | 0.10 |
| o-Xylene | 3.79 | 2.17 | 2.00 | 4.03 | 3.89 |
| 1-Nonene | ND | ND | ND | ND | ND |
| n-Nonane | 5.84 | 3.57 | 3.23 | 5.63 | 6.53 |
| 4-Nonene | 0.17 | ND | 0.72 | ND | ND |
| Cumene | 0.71 | 0.63 | 0.71 | 0.62 | 0.81 |
| a-Pinene | 8.50 | 7.85 | 2.03 | 10.1 | 8.17 |
| Benzaldehyde | 0.17 | ND | 0.60 | ND | ND |
| o-Chlorotoluene | 0.18 | ND | 0.96 | ND | ND |
| m-Chlorotoluene | 0.18 | ND | 0.42 | ND | 0.19 |

# Table 5-15
# (Continued)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| n-Propylbenzene | 2.74 | 2.09 | 2.29 | 2.47 | 3.10 |
| p-Chlorotoluene | ND | ND | ND | ND | ND |
| m-Ethyltoluene | 3.59 | 2.49 | 1.37 | 3.36 | 4.23 |
| p-Ethyltoluene | 2.32 | 2.01 | 1.58 | 2.23 | 2.55 |
| 1,3,5-Trimethylbenzene | 2.51 | 1.76 | 2.71 | 2.05 | 2.93 |
| o-Ethyltoluene | 4.32 | 3.43 | 4.51 | 3.57 | 5.03 |
| b-Pinene | 1.74 | 0.70 | 3.36 | 1.40 | 1.78 |
| 1-Decene | 0.26 | 0.19 | ND | 0.23 | 0.33 |
| Isobutylbenzene | 0.80 | 0.86 | 0.90 | 0.74 | 0.83 |
| 1,2,3-Trimethylbenzene | 1.29 | 1.90 | 0.98 | 1.16 | 1.48 |
| p-Isopropyltoluene | 0.54 | 1.22 | 0.41 | 0.89 | 0.25 |
| o-Dichlorobenzene | 1.59 | 2.17 | 1.63 | 1.32 | 1.85 |
| Limonene | 15.1 | 35.4 | 3.90 | 19.5 | 12.9 |
| Indan | 1.17 | ND | ND | 1.12 | 1.40 |
| Indene | ND | ND | ND | ND | ND |
| m-Diethylbenzene | 1.26 | 1.46 | 1.51 | 1.00 | 1.48 |
| n-Butylbenzene | 1.17 | 1.38 | 1.78 | 0.77 | 1.45 |
| p-Diethylbenzene | 2.49 | 2.67 | 3.87 | 1.67 | 3.04 |
| 1-Undecene | 0.72 | 1.37 | 1.03 | 0.51 | 0.87 |
| n-Undecane | 2.45 | 5.50 | 2.40 | 2.09 | 2.81 |
| Dichlorotoluene | 0.30 | 0.89 | 0.33 | 0.23 | 0.36 |
| Naphthalene | 0.18 | 0.80 | 0.26 | 0.13 | 0.21 |
| Total Unidentified VOCs | 122 | 135 | 83.5 | 117 | 134 |
| Chloroprene | 0.15 | ND | ND | ND | 0.11 |
| Ethylene | ND | ND | ND | ND | ND |
| Chlorodifluoromethane | ND | ND | ND | ND | ND |
| Freon 113 | 0.40 | 0.25 | ND | 0.33 | 0.43 |
| Vinyl Acetate | 0.14 | ND | ND | 0.14 | ND |
| Hexachloro-1,3-Butadiene | 0.16 | 0.48 | 0.09 | 0.20 | 0.13 |
| Bromochloromethane | 0.12 | ND | ND | ND | 0.15 |

# Table 5-15
## (Continued)

| Compound | Passive All Passive Vents | Gas Collection System | Section 1/9 Passive Vents | Section 2/8 Passive Vents | Section 3/4 Passive Vents |
|---|---|---|---|---|---|
| Freon 23 | ND | ND | ND | ND | ND |
| 1,2,4-Trichlorobenzene | 0.23 | 0.88 | 0.23 | 0.20 | 0.25 |
| Bromodichloromethane | 0.12 | ND | ND | 0.13 | 0.13 |
| Benzyl Chloride &m-Dichlorobenzene | 1.67 | 1.88 | 1.78 | 1.31 | 2.00 |
| n-Decane & p-Dichlorobenzene | 12.2 | 14.0 | 11.7 | 10.3 | 14.1 |
| Ethanol & Acetonitrile | 18.9 | ND | ND | 27.2 | 14.1 |
| 1,2,4-Trimethylbenzene & t-Butylben | 4.73 | 5.06 | 4.71 | 4.05 | 5.42 |
| Diethyl Ether &2-Propanol | 0.16 | ND | ND | ND | 0.17 |
| 2-Methylheptane | 0.15 | 0.14 | 0.13 | 0.20 | 0.14 |
| Trichloroethene | 0.40 | 0.24 | ND | 0.66 | 0.20 |
| Chloromethane/Halocarbon 114 | 0.25 | 0.23 | 0.14 | 0.23 | 0.30 |
| TNMHC | 417 | 438 | 273 | 439 | 423 |
| Ethane | 213 | 223 | 195 | 218 | 212 |

ND = Not Detected

# Table 5-16
# Ratio of Individual VOC to Total VOC Concentration Values (%)

| Compound | VOC to TNMHC Ratio (%) | | |
|---|---|---|---|
| | Gas Collection System | Passive Vents | Flux Chamber Samples |
| Ethane | 37.0 | 37.3 | 29.7 |
| Total Unidentified VOCs | 22.4 | 21.0 | 30.5 |
| Limonene | 9.8 | 4.3 | 2.2 |
| n-Decane & p-Dichlorobenzene | 3.1 | 2.8 | 6.1 |
| Toluene | 2.4 | 3.4 | 1.8 |
| a-Pinene | 2.2 | 2.4 | 2.1 |
| Propane | 2.2 | 2.7 | 1.8 |
| n-Undecane | 1.7 | 0.8 | 1.8 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 1.4 | 1.4 | 2.3 |
| p-Xylene + m-Xylene | 1.3 | 2.4 | 2.2 |
| Isobutane | 0.9 | 1.0 | 1.1 |
| n-Nonane | 0.9 | 1.5 | 1.9 |
| o-Ethyltoluene | 0.9 | 1.1 | 1.7 |
| Ethylbenzene | 0.8 | 1.2 | 1.5 |
| p-Diethylbenzene | 0.7 | 0.7 | 1.3 |
| n-Butane | 0.6 | 0.7 | 0.6 |
| m-Ethyltoluene | 0.6 | 0.9 | 0.9 |
| Isopentane | 0.5 | 0.3 | 0.2 |
| n-Propylbenzene | 0.5 | 0.7 | 0.9 |
| Acetone | 0.5 | 0.2 | 0.1 |
| 1,2,3-Trimethylbenzene | 0.5 | 0.3 | 0.5 |
| 1-Undecene | 0.4 | 0.2 | 0.0 |
| m-Diethylbenzene | 0.4 | 0.4 | 0.6 |
| n-Butylbenzene | 0.4 | 0.3 | 0.6 |
| o-Dichlorobenzene | 0.4 | 0.3 | 0.5 |
| o-Xylene | 0.4 | 0.7 | 0.7 |
| Styrene | 0.3 | 0.4 | 0.4 |
| p-Ethyltoluene | 0.3 | 0.4 | 0.6 |
| 3-Methylpentane | 0.3 | 0.1 | 0.0 |
| t-2-Pentene | 0.3 | 0.1 | 0.0 |
| p-Isopropyltoluene | 0.3 | 0.1 | 0.0 |
| Benzyl Chloride & m-Dichlorobenzene | 0.3 | 0.3 | 0.6 |
| 1,3,5-Trimethylbenzene | 0.3 | 0.4 | 0.7 |
| Isobutylbenzene | 0.2 | 0.2 | 0.4 |
| Naphthalene | 0.2 | 0.1 | 0.1 |
| n-Octane | 0.2 | 0.4 | 0.2 |
| Dichlorodifluoromethane | 0.2 | 0.3 | 0.4 |
| 1,1-Dichloroethylene | 0.2 | 0.2 | 0.0 |
| b-Pinene | 0.2 | 0.5 | 0.7 |
| Chlorobenzene | 0.2 | 0.4 | 0.3 |
| Dichlorotoluene | 0.2 | 0.1 | 0.0 |
| n-Pentane | 0.2 | 0.1 | 0.1 |
| Isopropylbenzene | 0.2 | 0.2 | 0.0 |
| Benzene | 0.2 | 0.1 | 0.1 |
| n-Hexane | 0.2 | 0.3 | 0.1 |
| 1,2,4-Trichlorobenzene | 0.1 | 0.0 | 0.1 |

# Table 5-16
# (Continued)

| Compound | VOC to TNMHC Ratio (%) | | |
|---|---|---|---|
| | Gas Collection System | Passive Vents | Flux Chamber Samples |
| n-Heptane | 0.1 | 0.2 | 0.1 |
| Trichlorofluoromethane | 0.1 | 0.1 | 0.1 |
| Isobutene + 1-Butene | 0.1 | 0.1 | 0.1 |
| Methylcyclohexane | 0.1 | 0.1 | 0.1 |
| Tetrachloroethylene | 0.1 | 0.1 | 0.0 |
| c-1,2-Dichloroethylene | 0.1 | 0.2 | 0.0 |
| Methylene Chloride | 0.1 | 0.2 | 0.0 |
| Isoheptane + 2,3-Dimethylpentane | 0.1 | 0.2 | 0.1 |
| Cyclohexane | 0.1 | 0.1 | 0.0 |
| 3-Methylhexane | 0.1 | 0.1 | 0.1 |
| 2,2,5-Trimethylhexane | 0.1 | 0.1 | 0.1 |
| 2,2,4-Trimethylpentane | 0.1 | 0.1 | 0.1 |
| Hexanal | 0.1 | 0.1 | 0.1 |
| 1,3-Butadiene | 0.1 | 0.0 | 0.0 |
| 1,1-Dichloroethane | 0.1 | 0.1 | 0.0 |
| Hexachloro-1,3-Butadiene | 0.1 | 0.0 | 0.0 |
| 3-Methylheptane | 0.1 | 0.1 | 0.0 |
| 1-Octene | 0.1 | 0.1 | 0.1 |
| Vinyl Chloride | 0.0 | 0.3 | 0.2 |
| Isohexane | 0.0 | 0.1 | 0.0 |
| Methylcyclopentane | 0.0 | 0.1 | 0.0 |
| 2-Methyl-2-Butene | 0.0 | 0.1 | 0.0 |
| Trichloroethene | 0.0 | 0.1 | 0.0 |
| Chloromethane/Halocarbon 114 | 0.0 | 0.0 | 0.0 |
| t-2-Hexene | 0.0 | 0.0 | 0.0 |
| t-3-Heptene | 0.0 | 0.0 | 0.0 |
| 2,5-Dimethylhexane | 0.0 | 0.0 | 0.0 |
| 1-Heptene | 0.0 | 0.0 | 0.0 |
| 1-Methylcyclohexene | 0.0 | 0.0 | 0.0 |
| Cyclopentane | 0.0 | 0.1 | 0.0 |
| 2,2,3-Trimethylpentane | 0.0 | 0.0 | 0.0 |
| 2-Methyl-1-Butene | 0.0 | 0.1 | 0.0 |
| 1,1,1-Trichloroethane | 0.0 | 0.0 | 0.0 |
| 1-Hexene | 0.0 | 0.1 | 0.0 |
| Neohexane | 0.0 | 0.0 | 0.0 |
| 2-Methylheptane | 0.0 | 0.0 | 0.0 |
| Freon 113 | 0.0 | 0.1 | 0.0 |
| 2-Methyl-2-Pentene | 0.0 | 0.1 | 0.0 |
| 2,3,4-Trimethylpentane | 0.0 | 0.1 | 0.0 |
| 1-Decene | 0.0 | 0.1 | 0.0 |
| Isoprene | 0.0 | 0.0 | 0.0 |
| Methylisobutylketone | 0.0 | 0.0 | 0.0 |
| t-2-Heptene | 0.0 | 0.0 | 0.0 |
| c-2-Pentene | 0.0 | 0.0 | 0.0 |
| 2,4-Dimethylpentane | 0.0 | 0.0 | 0.0 |

# Table 5-16
# (Continued)

| Compound | VOC to TNMHC Ratio (%) | | |
| --- | --- | --- | --- |
| | Gas Collection System | Passive Vents | Flux Chamber Samples |
| c-2-Butene | 0.0 | 0.0 | 0.0 |
| 1-Pentene | 0.0 | 0.0 | 0.0 |
| Chloroethane | 0.0 | 0.1 | 0.0 |
| t-2-Butene | 0.0 | 0.0 | 0.0 |
| Neopentane | 0.0 | 0.0 | 0.0 |
| 3-Methyl-1-Butene | 0.0 | 0.0 | 0.0 |
| 1,1,2,2-Tetrachloroethane | 0.0 | 0.0 | 0.0 |
| Dichlorofluoromethane | 0.0 | 0.0 | 0.0 |
| Diethyl Ether &2-Propanol | 0.0 | 0.0 | 0.0 |
| Cyclopentene | 0.0 | 0.0 | 0.0 |
| Dibromochloromethane | 0.0 | 0.0 | 0.0 |
| Dimethylsulfide | 0.0 | 0.0 | 0.0 |
| Ethanol & Acetonitrile | 0.0 | 1.1 | 0.2 |
| Dimethyl Acetal | 0.0 | 0.0 | 0.0 |
| Dimethyl Ether | 0.0 | 0.0 | 0.0 |
| Cyclohexene | 0.0 | 0.0 | 0.0 |
| 1,2-Dichloroethane | 0.0 | 0.0 | 0.0 |
| Chloroform | 0.0 | 0.0 | 0.0 |
| Carbon Tetrachloride | 0.0 | 0.0 | 0.0 |
| Chlorodifluoromethane | 0.0 | 0.0 | 0.0 |
| Cumene | 0.0 | 0.0 | 0.0 |
| Cyclohexanone | 0.0 | 0.0 | 0.0 |
| Chloromethane | 0.0 | 0.0 | 0.0 |
| Chloroprene | 0.0 | 0.0 | 0.0 |
| Ethyl Mercaptan | 0.0 | 0.0 | 0.0 |
| MTBE, Isohexane, & c-4-Methyl-2-Pentane | 0.0 | 0.0 | 0.0 |
| Methanol | 0.0 | 0.0 | 0.0 |
| Isopentyl Mercaptan | 0.0 | 0.0 | 0.0 |
| Isovaleraldehyde | 0.0 | 0.0 | 0.0 |
| Methyl Mercaptan | 0.0 | 0.0 | 0.0 |
| Methyl t-Butylether | 0.0 | 0.1 | 0.0 |
| Methyl Acrylate | 0.0 | 0.0 | 0.0 |
| Methyl Formate | 0.0 | 0.0 | 0.0 |
| Isobutyraldehyde | 0.0 | 0.0 | 0.0 |
| Freon 114 | 0.0 | 0.0 | 0.0 |
| Freon 23 | 0.0 | 0.0 | 0.0 |
| Ethylene | 0.0 | 0.0 | 0.0 |
| 1,2-Dibromoethane | 0.0 | 0.0 | 0.0 |
| Indene | 0.0 | 0.0 | 0.0 |
| Iodomethane | 0.0 | 0.0 | 0.0 |
| Heptanal | 0.0 | 0.0 | 0.0 |
| Indan | 0.0 | 0.3 | 0.0 |
| Butyraldehyde | 0.0 | 0.0 | 0.0 |
| 2-Butanone | 0.0 | 0.0 | 0.0 |
| 2-Butyne | 0.0 | 0.0 | 0.0 |

## Table 5-16
## (Continued)

| Compound | VOC to TNMHC Ratio (%) | | |
|---|---|---|---|
| | Gas Collection System | Passive Vents | Flux Chamber Samples |
| 1,4-Dioxane | 0.0 | 0.0 | 0.0 |
| 2,5-Dimethylthiophene | 0.0 | 0.0 | 0.0 |
| 2-Methyl-1,3-Dioxolane | 0.0 | 0.0 | 0.0 |
| 2-Methyl-1-Pentene | 0.0 | 0.0 | 0.0 |
| 2-Chloroethylvinyl Ether | 0.0 | 0.0 | 0.0 |
| 2-Ethyl-1-Butene | 0.0 | 0.0 | 0.0 |
| 2,4-4-Trimethyl-2-Pentene | 0.0 | 0.0 | 0.0 |
| 1-Nonene | 0.0 | 0.0 | 0.0 |
| 1-Butanol | 0.0 | 0.0 | 0.0 |
| 1-Butyne | 0.0 | 0.0 | 0.0 |
| 1-Butanol & Cyclohexane | 0.0 | 0.0 | 0.0 |
| 2,3-Dimethylbutane | 0.0 | 0.0 | 0.0 |
| 2,4,4-Trimethyl-1-Pentene | 0.0 | 0.0 | 0.0 |
| 1-Propanol | 0.0 | 0.0 | 0.0 |
| 1,4-Dioxane & 2,2,4-Trimethylpentane | 0.0 | 0.0 | 0.0 |
| 2-Methylthiophene | 0.0 | 0.0 | 0.0 |
| Bromochloromethane | 0.0 | 0.0 | 0.0 |
| Bromodichloromethane | 0.0 | 0.0 | 0.0 |
| Acrylonitrile | 0.0 | 0.0 | 0.0 |
| Benzaldehyde | 0.0 | 0.0 | 0.0 |
| Butyl Acrylate | 0.0 | 0.0 | 0.0 |
| Butyl Mercaptan | 0.0 | 0.0 | 0.0 |
| Bromoform | 0.0 | 0.0 | 0.0 |
| Bromomethane | 0.0 | 0.1 | 0.0 |
| Acetylene | 0.0 | 0.0 | 0.0 |
| 1,2-Dichloropropane | 0.0 | 0.0 | 0.0 |
| 3-Methylthiophene | 0.0 | 0.0 | 0.0 |
| 2-Pentanone | 0.0 | 0.0 | 0.0 |
| 3,5,5-Trimethylhexene | 0.0 | 0.0 | 0.0 |
| 4-Nonene | 0.0 | 0.0 | 0.0 |
| Acetaldehyde | 0.0 | 0.0 | 0.0 |
| 3-Octanone | 0.0 | 0.0 | 0.0 |
| 4-Methyl-1-Pentene | 0.0 | 0.0 | 0.0 |
| bis-Chloroethyl Ether | 0.0 | 0.0 | 0.0 |
| a-Pinene & Benzaldehyde | 0.0 | 0.0 | 0.0 |
| Vinyl Bromide | 0.0 | 0.0 | 0.0 |
| c-2-Hexene | 0.0 | 0.0 | 0.0 |
| c-1,3-Dichloropropene | 0.0 | 0.1 | 0.0 |
| bis-Chloromethyl Ether | 0.0 | 0.0 | 0.0 |
| Total Unidentified Halogenated VOCs | 0.0 | 0.0 | 0.0 |
| Thiophene | 0.0 | 0.0 | 0.0 |
| Tetrahydrothiophene | 0.0 | 0.0 | 0.0 |
| Vinyl Acetate | 0.0 | 0.0 | 0.0 |
| Valeraldehyde | 0.0 | 0.0 | 0.0 |
| Trichloroethylene + BCM | 0.0 | 0.0 | 0.0 |

# Table 5-16
# (Continued)

| Compound | VOC to TNMHC Ratio (%) | | |
| --- | --- | --- | --- |
| | Gas Collection System | Passive Vents | Flux Chamber Samples |
| t-1,2-Dichloroethylene | 0.0 | 0.0 | 0.0 |
| p-Chlorotoluene | 0.0 | 0.0 | 0.0 |
| o-Chlorotoluene | 0.0 | 0.0 | 0.0 |
| t-4-Methyl-2-Pentene | 0.0 | 0.0 | 0.0 |
| 1,1,2-Trichloroethane | 0.0 | 0.0 | 0.0 |
| t-1,3-Dichloropropene | 0.0 | 0.0 | 0.0 |
| c-3-Hexene | 0.0 | 0.0 | 0.0 |
| c-3-Heptene | 0.0 | 0.0 | 0.0 |
| c-2-Octene | 0.0 | 0.0 | 0.0 |
| m-Chlorotoluene | 0.0 | 0.0 | 0.0 |
| c-4-Methyl-2-Pentene | 0.0 | 0.0 | 0.0 |
| c-3-Methyl-2-Pentene | 0.0 | 0.0 | 0.0 |
| Propyne | 0.0 | 0.0 | 0.0 |
| Propylene | 0.0 | 0.0 | 0.0 |
| Propionaldehyde | 0.0 | 0.0 | 0.0 |
| Methylcyclopentene | 0.0 | 0.0 | 0.0 |

# Table 5-17
## Landfill Gas Production and Emission Rates for Fresh Kills Landfill

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| Carbon Dioxide | 1.14e+04 | 6.28e+01 | 3.83e+03 | 4.42e+03 | 9.52e+02 | 1.20e+04 | 8.03e+02 | 9.92e+03 | 4.34e+04 | 3.96e+04 |
| Methane | 6.34e+03 | 3.25e+01 | 2.09e+03 | 3.24e+03 | 4.82e+02 | 6.82e+03 | 4.27e+02 | 4.50e+03 | 2.39e+04 | 2.18e+04 |
| TNMHC | 5.94e+00 | 8.51e-02 | 8.02e+00 | 4.09e+00 | 1.97e+00 | 7.53e+00 | 1.83e+00 | 1.19e+01 | 4.14e+01 | 3.34e+01 |
| Total Unidentified VOCs | 2.66e+00 | 2.68e-02 | 2.45e+00 | 2.06e+00 | 5.28e-01 | 4.36e+00 | 6.00e-01 | 4.41e+00 | 1.71e+01 | 1.46e+01 |
| Ethane | 1.75e-02 | 2.03e-02 | 1.42e+00 | 5.64e-02 | 3.65e-01 | 4.57e-02 | 3.02e-01 | 1.01e+00 | 3.24e+00 | 1.81e+00 |
| Isopentane | 3.78e-01 | 1.81e-05 | 5.01e-02 | 3.28e-02 | 1.65e-02 | 3.74e-02 | 1.68e-03 | 1.04e+00 | 1.55e+00 | 1.50e+00 |
| n-Decane & p-Dichlorobenzene | 1.25e-01 | 6.54e-03 | 4.27e-01 | 1.33e-01 | 7.68e-02 | 2.19e-01 | 1.05e-01 | 7.73e-01 | 1.87e+00 | 1.44e+00 |
| Isobutane | 3.11e-01 | 6.83e-04 | 1.03e-01 | 1.26e-01 | 3.64e-02 | 8.98e-02 | 2.49e-02 | 4.63e-01 | 1.15e+00 | 1.05e+00 |
| Limonene | 1.74e-01 | 1.92e-03 | 1.03e+00 | 6.41e-02 | 1.45e-01 | 1.26e-01 | 8.44e-02 | 2.87e-01 | 1.91e+00 | 8.82e-01 |
| Toluene | 1.28e-01 | 5.81e-04 | 2.94e-01 | 1.06e-02 | 1.23e-01 | 1.14e-01 | 7.72e-02 | 3.48e-01 | 1.10e+00 | 8.02e-01 |
| Acetone | 4.70e-01 | 1.48e-05 | 8.74e-02 | 6.13e-02 | 1.45e-02 | 4.85e-02 | 2.22e-03 | 1.14e-01 | 7.98e-01 | 7.10e-01 |
| n-Propylbenzene | 1.32e-01 | 1.01e-03 | 5.40e-02 | 9.98e-02 | 1.50e-02 | 2.93e-01 | 1.91e-02 | 1.20e-01 | 7.34e-01 | 6.80e-01 |
| p/m-Xylene | 7.89e-02 | 2.00e-03 | 1.39e-01 | 1.27e-01 | 5.55e-02 | 8.02e-02 | 5.75e-02 | 2.20e-01 | 7.59e-01 | 6.21e-01 |
| Ethylbenzene | 7.39e-02 | 1.68e-03 | 1.06e-01 | 1.63e-01 | 3.55e-02 | 8.17e-02 | 4.19e-02 | 1.96e-01 | 7.00e-01 | 5.94e-01 |
| Propane | 5.51e-02 | 1.30e-03 | 1.25e-01 | 1.41e-01 | 4.08e-02 | 7.96e-02 | 3.49e-02 | 2.33e-01 | 7.11e-01 | 5.85e-01 |
| 1,2,3-Trimethylbenzene | 6.13e-02 | 4.35e-04 | 4.75e-02 | 7.03e-02 | 6.77e-03 | 3.82e-01 | 9.57e-03 | 4.92e-02 | 6.27e-01 | 5.79e-01 |
| n-Butane | 6.15e-02 | 3.99e-04 | 4.70e-02 | 7.38e-02 | 1.48e-02 | 7.46e-02 | 1.10e-02 | 3.18e-01 | 6.01e-01 | 5.54e-01 |
| p-Ethyltoluene | 8.71e-02 | 7.20e-04 | 5.05e-02 | 7.46e-02 | 1.25e-02 | 2.16e-01 | 1.57e-02 | 1.04e-01 | 5.61e-01 | 5.11e-01 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 7.45e-02 | 2.16e-03 | 1.34e-01 | 4.68e-03 | 2.58e-02 | 1.47e-01 | 3.51e-02 | 2.06e-01 | 6.29e-01 | 4.96e-01 |
| n-Nonane | 8.16e-02 | 1.64e-03 | 1.00e-01 | 7.69e-02 | 3.65e-02 | 4.07e-02 | 4.37e-02 | 2.00e-01 | 5.81e-01 | 4.81e-01 |
| 1,3,5-Trimethylbenzene | 1.01e-01 | 1.19e-03 | 4.56e-02 | 5.68e-02 | 1.30e-02 | 1.82e-01 | 1.76e-02 | 1.03e-01 | 5.21e-01 | 4.75e-01 |
| Hydrogen Sulfide | 3.04e-02 | 3.36e-03 | 6.51e-01 | 7.76e-03 | 6.97e-02 | 3.76e-03 | 7.97e-02 | 2.58e-01 | 1.10e+00 | 4.53e-01 |
| n-Butylbenzene | 4.96e-02 | 8.42e-04 | 4.23e-02 | 6.58e-02 | 4.87e-03 | 1.73e-01 | 9.94e-03 | 7.23e-02 | 4.19e-01 | 3.77e-01 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System* | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| n-Pentane | 7.46e-02 | 5.35e-05 | 1.31e-02 | 1.16e-02 | 5.79e-03 | 3.57e-02 | 1.42e-03 | 1.78e-01 | 3.20e-01 | 3.07e-01 |
| Methylene Chloride | 1.89e-01 | 0.00e+00 | 9.14e-03 | 9.11e-04 | 9.81e-03 | 2.00e-03 | 1.57e-04 | 9.78e-02 | 3.09e-01 | 3.00e-01 |
| Dichlorodifluoromethane | 1.02e-01 | 9.99e-05 | 3.48e-02 | 3.12e-02 | 1.44e-02 | 2.05e-02 | 5.76e-03 | 1.24e-01 | 3.33e-01 | 2.98e-01 |
| m-Ethyltoluene | 4.09e-02 | 6.10e-04 | 6.32e-02 | 5.38e-02 | 1.99e-02 | 6.83e-02 | 2.57e-02 | 8.78e-02 | 3.60e-01 | 2.97e-01 |
| a-Pinene & Benzaldehyde | 0.00e+00 | 1.20e-03 | 2.33e-01 | 0.00e+00 | 6.91e-02 | 0.00e+00 | 5.53e-02 | 1.70e-01 | 2.95e-01 | 2.95e-01 |
| Ethanol & Acetonitrile | 9.10e-04 | 0.00e+00 | 0.00e+00 | 2.88e-02 | 6.32e-02 | 6.09e-04 | 2.43e-02 | 1.55e-01 | 2.73e-01 | 2.73e-01 |
| o-Ethyltoluene | 1.81e-02 | 1.98e-03 | 8.77e-02 | 1.16e-02 | 2.15e-02 | 2.78e-02 | 3.13e-02 | 1.55e-01 | 3.55e-01 | 2.67e-01 |
| Indene | 7.55e-02 | 0.00e+00 | 0.00e+00 | 7.61e-02 | 0.00e+00 | 8.50e-02 | 0.00e+00 | 1.22e-02 | 2.49e-01 | 2.49e-01 |
| o-Xylene | 3.41e-02 | 8.14e-04 | 4.99e-02 | 2.34e-02 | 2.06e-02 | 5.22e-02 | 2.12e-02 | 9.54e-02 | 2.98e-01 | 2.48e-01 |
| Acetylene | 1.06e-04 | 0.00e+00 | 0.00e+00 | 9.51e-02 | 0.00e+00 | 1.24e-01 | 0.00e+00 | 3.44e-04 | 2.19e-01 | 2.19e-01 |
| 1,1-Dichloroethane | 1.72e-01 | 1.55e-06 | 9.33e-03 | 1.87e-03 | 6.28e-03 | 1.63e-03 | 1.01e-03 | 3.27e-02 | 2.25e-01 | 2.16e-01 |
| Isobutene + 1-Butene | 5.49e-02 | 2.72e-04 | 1.14e-02 | 2.08e-02 | 2.56e-03 | 1.12e-01 | 3.36e-03 | 2.00e-02 | 2.25e-01 | 2.13e-01 |
| n-Undecane | 5.64e-04 | 1.47e-03 | 1.74e-01 | 1.22e-03 | 1.63e-02 | 0.00e+00 | 2.18e-02 | 1.72e-01 | 3.87e-01 | 2.13e-01 |
| Styrene | 3.81e-02 | 3.27e-04 | 4.70e-02 | 2.42e-02 | 1.62e-02 | 6.16e-02 | 1.18e-02 | 5.96e-02 | 2.59e-01 | 2.12e-01 |
| Diethyl Ether & 2-Propanol | 3.86e-02 | 0.00e+00 | 0.00e+00 | 4.36e-03 | 0.00e+00 | 3.56e-03 | 1.72e-04 | 1.39e-01 | 1.86e-01 | 1.86e-01 |
| Hexanal | 2.37e-02 | 8.40e-05 | 8.60e-03 | 2.66e-02 | 4.78e-03 | 4.87e-02 | 3.39e-03 | 5.77e-02 | 1.73e-01 | 1.65e-01 |
| n-Octane | 1.51e-02 | 2.00e-04 | 2.57e-02 | 3.25e-02 | 1.25e-02 | 2.66e-02 | 7.87e-03 | 6.97e-02 | 1.90e-01 | 1.64e-01 |
| Propylene | 2.11e-02 | 0.00e+00 | 0.00e+00 | 4.80e-02 | 0.00e+00 | 5.61e-02 | 0.00e+00 | 3.66e-02 | 1.62e-01 | 1.62e-01 |
| Chlorobenzene | 7.96e-03 | 5.13e-04 | 2.88e-02 | 3.65e-02 | 1.26e-02 | 5.69e-02 | 1.23e-02 | 3.26e-02 | 1.88e-01 | 1.59e-01 |
| p-Diethylbenzene | 1.84e-03 | 1.83e-03 | 7.50e-02 | 2.02e-03 | 1.15e-02 | 0.00e+00 | 2.08e-02 | 1.17e-01 | 2.30e-01 | 1.55e-01 |
| n-Hexane | 5.89e-02 | 7.75e-05 | 1.64e-02 | 1.77e-02 | 1.77e-02 | 2.29e-02 | 2.43e-03 | 2.38e-02 | 1.60e-01 | 1.44e-01 |
| t-2-Butene | 1.05e-01 | 8.23e-06 | 1.73e-03 | 1.59e-03 | 3.68e-04 | 3.10e-03 | 7.11e-04 | 2.54e-02 | 1.37e-01 | 1.36e-01 |
| Benzyl Chloride & m-Dichlorobenzene | 0.00e+00 | 9.26e-04 | 5.38e-02 | 0.00e+00 | 8.77e-03 | 3.81e-05 | 1.39e-02 | 9.02e-02 | 1.68e-01 | 1.14e-01 |
| Tetrachloroethylene | 6.43e-02 | 2.98e-05 | 2.20e-02 | 3.82e-03 | 1.02e-02 | 1.55e-03 | 2.02e-03 | 2.70e-02 | 1.31e-01 | 1.09e-01 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| n-Heptane | 3.90e-02 | 1.49e-04 | 1.46e-02 | 2.32e-02 | 6.60e-03 | 1.28e-02 | 3.54e-03 | 2.36e-02 | 1.24e-01 | 1.09e-01 |
| o-Dichlorobenzene | 0.00e+00 | 8.85e-04 | 6.68e-02 | 0.00e+00 | 9.83e-03 | 0.00e+00 | 1.44e-02 | 7.69e-02 | 1.69e-01 | 1.02e-01 |
| Methylcyclohexane | 3.62e-02 | 9.02e-05 | 1.10e-02 | 1.77e-02 | 5.09e-03 | 1.73e-02 | 2.55e-03 | 2.08e-02 | 1.11e-01 | 9.97e-02 |
| 3-Methylhexane | 3.74e-02 | 5.71e-05 | 8.35e-03 | 5.76e-03 | 4.76e-03 | 1.22e-02 | 1.79e-03 | 2.66e-02 | 9.69e-02 | 8.86e-02 |
| b-Pinene | 0.00e+00 | 1.53e-03 | 1.79e-02 | 3.71e-03 | 1.07e-02 | 9.09e-05 | 1.26e-02 | 5.98e-02 | 1.06e-01 | 8.85e-02 |
| Trichlorofluoromethane | 1.57e-02 | 4.83e-06 | 1.83e-02 | 6.75e-04 | 4.15e-03 | 9.49e-04 | 8.92e-04 | 6.03e-02 | 1.01e-01 | 8.27e-02 |
| 3-Methylpentane | 4.25e-02 | 3.13e-05 | 2.21e-01 | 5.66e-03 | 5.39e-03 | 1.49e-02 | 6.76e-04 | 1.26e-02 | 3.02e-01 | 8.18e-02 |
| m-Diethylbenzene | 4.03e-05 | 7.21e-04 | 3.86e-02 | 5.67e-04 | 6.88e-03 | 0.00e+00 | 1.01e-02 | 5.39e-02 | 1.11e-01 | 7.22e-02 |
| 3-Methylheptane | 4.41e-03 | 6.82e-05 | 6.00e-03 | 1.86e-02 | 3.25e-03 | 1.51e-02 | 2.14e-03 | 2.36e-02 | 7.32e-02 | 6.72e-02 |
| Isoheptane + 2,3-Dimethylpentane | 8.89e-03 | 7.99e-05 | 1.01e-02 | 1.26e-02 | 6.55e-03 | 1.39e-02 | 2.87e-03 | 2.13e-02 | 7.64e-02 | 6.62e-02 |
| Chloroethane | 3.66e-02 | 2.40e-06 | 1.72e-03 | 4.19e-03 | 1.68e-03 | 1.30e-03 | 3.96e-04 | 1.89e-02 | 6.48e-02 | 6.30e-02 |
| t-2-Pentene | 2.23e-02 | 6.75e-06 | 3.42e-02 | 6.16e-04 | 1.57e-03 | 1.96e-02 | 1.02e-03 | 6.32e-03 | 8.56e-02 | 5.15e-02 |
| 2,2,5-Trimethylhexane | 5.16e-03 | 1.86e-05 | 7.59e-03 | 8.58e-03 | 1.44e-03 | 1.34e-02 | 1.20e-03 | 2.07e-02 | 5.81e-02 | 5.05e-02 |
| Vinyl Chloride | 1.69e-02 | 2.92e-05 | 3.88e-03 | 0.00e+00 | 7.28e-03 | 1.17e-03 | 5.57e-03 | 1.91e-02 | 5.39e-02 | 5.00e-02 |
| Methylcyclopentane | 2.35e-02 | 3.56e-05 | 4.77e-03 | 5.03e-03 | 2.71e-03 | 6.35e-03 | 1.26e-03 | 7.70e-03 | 5.14e-02 | 4.66e-02 |
| Benzene | 9.45e-03 | 2.30e-04 | 1.60e-02 | 8.96e-03 | 2.08e-03 | 9.37e-03 | 1.96e-03 | 1.17e-02 | 5.97e-02 | 4.37e-02 |
| 1,1,1-Trichloroethane | 4.09e-03 | 0.00e+00 | 5.02e-03 | 2.23e-05 | 1.38e-03 | 1.79e-03 | 4.46e-04 | 3.58e-02 | 4.85e-02 | 4.35e-02 |
| Isobutylbenzene | 0.00e+00 | 4.32e-04 | 2.44e-02 | 0.00e+00 | 5.18e-03 | 0.00e+00 | 5.68e-03 | 3.14e-02 | 6.72e-02 | 4.27e-02 |
| Chloromethane/Halocarbon 114 | 1.05e-02 | 0.00e+00 | 0.00e+00 | 3.45e-03 | 0.00e+00 | 1.22e-02 | 0.00e+00 | 1.42e-02 | 4.03e-02 | 4.03e-02 |
| c-1,2-Dichloroethylene | 1.78e-02 | 4.23e-06 | 1.20e-02 | 1.32e-04 | 7.77e-03 | 6.54e-04 | 1.86e-03 | 1.15e-02 | 5.18e-02 | 3.97e-02 |
| Cumene | 4.23e-04 | 3.08e-04 | 1.61e-02 | 5.49e-05 | 3.46e-03 | 7.06e-03 | 5.12e-03 | 2.26e-02 | 5.52e-02 | 3.91e-02 |
| Ethylene | 1.93e-03 | 0.00e+00 | 0.00e+00 | 6.70e-03 | 0.00e+00 | 1.73e-02 | 0.00e+00 | 1.28e-02 | 3.88e-02 | 3.88e-02 |
| Trichloroethylene | 1.84e-02 | 0.00e+00 | 0.00e+00 | 4.09e-05 | 0.00e+00 | 3.67e-04 | 0.00e+00 | 1.73e-02 | 3.61e-02 | 3.61e-02 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| 2,3,4-Trimethylpentane | 1.00e-02 | 1.97e-05 | 2.69e-03 | 4.95e-03 | 3.57e-03 | 6.66e-03 | 9.24e-04 | 9.14e-03 | 3.80e-02 | 3.53e-02 |
| 2-Methyl-1-Butene | 9.98e-03 | 5.92e-05 | 3.83e-03 | 3.70e-03 | 1.92e-03 | 8.08e-03 | 1.10e-03 | 9.89e-03 | 3.86e-02 | 3.47e-02 |
| Neohexane | 1.30e-02 | 1.02e-05 | 3.13e-03 | 3.18e-03 | 8.19e-04 | 4.96e-03 | 4.44e-04 | 5.85e-03 | 3.14e-02 | 2.82e-02 |
| 2-Methyl-2-Butene | 2.01e-03 | 5.00e-05 | 4.21e-03 | 1.26e-03 | 2.15e-03 | 7.25e-03 | 7.61e-04 | 1.32e-02 | 3.08e-02 | 2.66e-02 |
| 2,2,3-Trimethylpentane | 7.16e-03 | 0.00e+00 | 3.66e-03 | 4.08e-03 | 1.33e-03 | 8.43e-03 | 3.36e-04 | 4.59e-03 | 2.96e-02 | 2.59e-02 |
| c-2-Pentene | 2.14e-02 | 0.00e+00 | 1.77e-03 | 0.00e+00 | 4.74e-04 | 1.04e-03 | 3.63e-05 | 1.62e-04 | 2.48e-02 | 2.31e-02 |
| Hexachloro-1,3-Butadiene | 0.00e+00 | 6.59e-05 | 2.57e-02 | 0.00e+00 | 1.41e-03 | 0.00e+00 | 7.02e-04 | 2.03e-02 | 4.82e-02 | 2.25e-02 |
| Methanol | 5.69e-03 | 0.00e+00 | 0.00e+00 | 1.71e-03 | 0.00e+00 | 4.27e-03 | 8.65e-05 | 1.06e-02 | 2.23e-02 | 2.23e-02 |
| 2,5-Dimethylhexane | 4.82e-03 | 0.00e+00 | 5.09e-03 | 3.78e-03 | 8.65e-04 | 6.00e-03 | 3.39e-04 | 3.92e-03 | 2.48e-02 | 1.97e-02 |
| Naphthalene | 2.28e-03 | 1.16e-04 | 2.00e-02 | 2.57e-03 | 8.19e-04 | 5.14e-04 | 1.28e-03 | 1.20e-02 | 3.96e-02 | 1.96e-02 |
| 1,2,4-Trichlorobenzene | 0.00e+00 | 1.51e-04 | 3.28e-02 | 0.00e+00 | 1.65e-03 | 0.00e+00 | 2.09e-03 | 1.35e-02 | 5.02e-02 | 1.74e-02 |
| 1-Octene | 3.27e-04 | 5.19e-05 | 5.92e-03 | 1.54e-03 | 2.72e-03 | 2.86e-03 | 1.84e-03 | 7.26e-03 | 2.25e-02 | 1.66e-02 |
| Cyclopentane | 8.10e-04 | 0.00e+00 | 3.79e-03 | 9.92e-04 | 2.26e-03 | 2.23e-03 | 4.65e-04 | 9.79e-03 | 2.03e-02 | 1.65e-02 |
| MTBE, Isohexane, & c-4-Methyl-2-Pentene | 0.00e+00 | 3.62e-05 | 4.56e-03 | 0.00e+00 | 1.27e-02 | 0.00e+00 | 1.49e-03 | 2.29e-03 | 1.65e-02 | 1.65e-02 |
| Indan | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 6.93e-03 | 0.00e+00 | 8.67e-03 | 0.00e+00 | 1.56e-02 | 1.56e-02 |
| Freon 113 | 7.62e-03 | 0.00e+00 | 1.44e-03 | 6.55e-06 | 1.90e-04 | 5.20e-04 | 3.35e-06 | 6.97e-03 | 1.68e-02 | 1.53e-02 |
| 1,4-Dioxane & 2,2,4-Trimethylpentane | 0.00e+00 | 3.32e-05 | 7.76e-03 | 0.00e+00 | 5.54e-03 | 0.00e+00 | 2.42e-03 | 7.29e-03 | 1.53e-02 | 1.53e-02 |
| 3-Methyl-1-Butene | 2.22e-03 | 2.80e-05 | 1.92e-03 | 1.79e-03 | 3.50e-04 | 5.80e-03 | 3.58e-04 | 2.55e-03 | 1.50e-02 | 1.31e-02 |
| 1-Hexene | 4.65e-03 | 0.00e+00 | 3.73e-03 | 7.70e-05 | 2.11e-03 | 2.02e-03 | 4.94e-04 | 3.04e-03 | 1.61e-02 | 1.24e-02 |
| 1-Undecene | 0.00e+00 | 5.01e-04 | 6.36e-02 | 0.00e+00 | 3.70e-03 | 0.00e+00 | 5.97e-03 | 2.66e-04 | 7.41e-02 | 1.04e-02 |
| c-2-Butene | 6.55e-03 | 0.00e+00 | 6.74e-04 | 6.10e-04 | 2.03e-04 | 1.85e-03 | 1.97e-04 | 9.15e-04 | 1.10e-02 | 1.03e-02 |
| Methylisobutylketone | 4.24e-04 | 0.00e+00 | 7.90e-04 | 1.83e-03 | 4.08e-04 | 6.25e-03 | 7.06e-05 | 8.11e-04 | 1.06e-02 | 9.79e-03 |
| 1-Butanol & Cyclohexane | 0.00e+00 | 5.65e-05 | 8.59e-03 | 0.00e+00 | 5.82e-03 | 0.00e+00 | 2.72e-03 | 0.00e+00 | 8.59e-03 | 8.59e-03 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| 2-Methyl-2-Pentene | 3.49e-03 | 1.00e-06 | 3.08e-03 | 0.00e+00 | 1.12e-03 | 2.62e-03 | 6.98e-04 | 2.98e-04 | 1.13e-02 | 8.23e-03 |
| 2,4-Dimethylpentane | 7.63e-04 | 0.00e+00 | 2.85e-03 | 1.41e-03 | 5.97e-04 | 2.11e-03 | 4.68e-04 | 2.57e-03 | 1.08e-02 | 7.92e-03 |
| 2,3-Dimethylbutane | 7.47e-04 | 0.00e+00 | 0.00e+00 | 1.29e-03 | 0.00e+00 | 2.45e-03 | 8.26e-05 | 2.59e-03 | 7.16e-03 | 7.16e-03 |
| Trichloroethene | 0.00e+00 | 0.00e+00 | 7.12e-03 | 0.00e+00 | 4.50e-03 | 0.00e+00 | 8.06e-04 | 1.67e-03 | 1.41e-02 | 6.98e-03 |
| 1-Pentene | 7.31e-04 | 0.00e+00 | 2.22e-03 | 1.26e-03 | 1.81e-04 | 1.98e-03 | 1.39e-04 | 1.58e-03 | 8.08e-03 | 5.86e-03 |
| Isoprene | 1.44e-03 | 0.00e+00 | 2.50e-03 | 4.00e-05 | 5.39e-04 | 5.86e-04 | 3.65e-04 | 2.67e-03 | 8.14e-03 | 5.64e-03 |
| Mercury | NM | 3.15e-04 | 2.84e-02 | NM | 2.84e-03 | NM | 2.29e-03 | 0.00e+00 | 3.38e-02 | 5.45e-03 |
| 1,1-Dichloroethylene | 2.12e-03 | 0.00e+00 | 1.64e-03 | 0.00e+00 | 1.38e-04 | 2.99e-04 | 5.06e-05 | 2.00e-03 | 6.24e-03 | 4.61e-03 |
| t-1,3-Dichloropropene | 1.56e-03 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.42e-05 | 4.00e-04 | 7.03e-06 | 2.60e-03 | 4.58e-03 | 4.58e-03 |
| t-1,2-Dichloroethylene | 3.87e-03 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.90e-04 | 6.46e-05 | 2.60e-05 | 3.11e-04 | 4.46e-03 | 4.46e-03 |
| Dichlorotoluene | 0.00e+00 | 1.72e-04 | 3.93e-02 | 0.00e+00 | 1.35e-03 | 0.00e+00 | 2.46e-03 | 1.10e-04 | 4.34e-02 | 4.09e-03 |
| 1,3-Butadiene | 1.15e-03 | 0.00e+00 | 2.72e-02 | 0.00e+00 | 0.00e+00 | 2.10e-03 | 0.00e+00 | 3.60e-04 | 3.08e-02 | 3.61e-03 |
| 1,1,2,2-Tetrachloroethane | 5.46e-04 | 8.68e-06 | 7.53e-04 | 0.00e+00 | 1.98e-04 | 4.73e-05 | 3.42e-04 | 2.13e-03 | 4.03e-03 | 3.28e-03 |
| c-3-Hexene | 3.56e-04 | 0.00e+00 | 0.00e+00 | 6.77e-04 | 4.72e-04 | 1.12e-03 | 1.48e-05 | 5.08e-04 | 3.15e-03 | 3.15e-03 |
| 1-Decene | 0.00e+00 | 0.00e+00 | 3.97e-03 | 0.00e+00 | 8.14e-04 | 0.00e+00 | 1.84e-03 | 0.00e+00 | 6.63e-03 | 2.66e-03 |
| 1,2-Dichloropropane | 6.11e-05 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 8.43e-05 | 3.74e-06 | 2.30e-03 | 2.45e-03 | 2.45e-03 |
| p-Isopropyltoluene | 0.00e+00 | 3.03e-05 | 2.22e-01 | 0.00e+00 | 1.84e-03 | 0.00e+00 | 3.86e-04 | 0.00e+00 | 2.25e-01 | 2.25e-03 |
| c-3-Heptene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.34e-03 | 0.00e+00 | 6.13e-04 | 0.00e+00 | 1.95e-03 | 1.95e-03 |
| Chlorodifluoromethane | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.89e-03 | 1.89e-03 | 1.89e-03 |
| t-2-Hexene | 3.25e-04 | 0.00e+00 | 8.76e-03 | 4.00e-05 | 2.91e-05 | 8.62e-04 | 3.11e-05 | 2.93e-04 | 1.03e-02 | 1.58e-03 |
| Chloroform | 2.44e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 9.12e-04 | 0.00e+00 | 4.18e-04 | 1.57e-03 | 1.57e-03 |
| Heptanal | 0.00e+00 | 5.90e-06 | 0.00e+00 | 0.00e+00 | 5.69e-04 | 7.40e-05 | 7.59e-04 | 0.00e+00 | 1.41e-03 | 1.41e-03 |
| Bromomethane | 0.00e+00 | 6.33e-06 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.18e-03 | 1.14e-04 | 1.30e-03 | 1.30e-03 |
| 2-Methylheptane | 0.00e+00 | 1.37e-05 | 3.01e-03 | 0.00e+00 | 6.63e-04 | 0.00e+00 | 3.76e-04 | 0.00e+00 | 4.06e-03 | 1.05e-03 |
| c-2-Octene | 0.00e+00 | 2.03e-05 | 0.00e+00 | 0.00e+00 | 2.80e-04 | 0.00e+00 | 7.51e-04 | 0.00e+00 | 1.05e-03 | 1.05e-03 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| 1,2-Dichloroethane | 4.62e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 7.13e-05 | 2.24e-05 | 0.00e+00 | 4.75e-04 | 1.03e-03 | 1.03e-03 |
| t-3-Heptene | 0.00e+00 | 2.26e-05 | 5.03e-03 | 0.00e+00 | 1.32e-04 | 0.00e+00 | 8.42e-04 | 0.00e+00 | 6.03e-03 | 9.96e-04 |
| t-2-Heptene | 0.00e+00 | 8.68e-06 | 8.53e-04 | 0.00e+00 | 5.48e-04 | 0.00e+00 | 3.00e-04 | 0.00e+00 | 1.71e-03 | 8.57e-04 |
| 3,5,5-Trimethylhexene | 0.00e+00 | 2.84e-05 | 0.00e+00 | 0.00e+00 | 2.18e-04 | 0.00e+00 | 5.43e-04 | 0.00e+00 | 7.89e-04 | 7.89e-04 |
| 1,1,2-Trichloroethane | 1.17e-04 | 0.00e+00 | 0.00e+00 | 8.69e-05 | 0.00e+00 | 2.57e-04 | 0.00e+00 | 3.04e-04 | 7.64e-04 | 7.64e-04 |
| 2-Methyl-1-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 7.44e-04 | 0.00e+00 | 7.44e-04 | 7.44e-04 |
| 1,2-Dibromoethane | 1.00e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.24e-04 | 1.83e-05 | 2.07e-04 | 6.49e-04 | 6.49e-04 |
| c-2-Hexene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 6.27e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 6.27e-04 | 6.27e-04 |
| c-1,3-Dichloropropene | 1.00e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.18e-04 | 1.10e-05 | 9.39e-05 | 2.95e-04 | 6.18e-04 | 6.18e-04 |
| Carbon Tetrachloride | 1.33e-04 | 2.13e-06 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.31e-05 | 0.00e+00 | 4.35e-04 | 6.03e-04 | 6.03e-04 |
| 1-Methylcyclohexene | 0.00e+00 | 0.00e+00 | 6.00e-03 | 0.00e+00 | 4.17e-04 | 0.00e+00 | 5.85e-05 | 9.58e-05 | 6.58e-03 | 5.72e-04 |
| m-Chlorotoluene | 0.00e+00 | 1.45e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.42e-04 | 0.00e+00 | 3.87e-04 | 3.87e-04 |
| o-Chlorotoluene | 0.00e+00 | 3.73e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.73e-04 | 3.73e-04 |
| Bromodichloromethane | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.86e-05 | 0.00e+00 | 1.68e-04 | 1.20e-04 | 3.17e-04 | 3.17e-04 |
| 1-Heptene | 0.00e+00 | 0.00e+00 | 3.69e-03 | 0.00e+00 | 2.93e-05 | 0.00e+00 | 2.74e-04 | 0.00e+00 | 3.99e-03 | 3.04e-04 |
| 4-Nonene | 0.00e+00 | 2.85e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.85e-04 | 2.85e-04 |
| Cyclohexene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.24e-04 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.24e-04 | 2.24e-04 |
| Cyclopentene | 0.00e+00 | 1.81e-05 | 0.00e+00 | 0.00e+00 | 9.69e-05 | 0.00e+00 | 7.19e-05 | 0.00e+00 | 1.87e-04 | 1.87e-04 |
| 2-Butanone | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.69e-04 | 0.00e+00 | 1.69e-04 | 1.69e-04 |
| 2-Ethyl-1-Butene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.07e-05 | 0.00e+00 | 1.39e-04 | 0.00e+00 | 1.50e-04 | 1.50e-04 |
| Dichlorofluoromethane | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.30e-04 | 1.30e-04 | 1.30e-04 |
| 2,4,4-Trimethyl-1-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.63e-05 | 0.00e+00 | 3.59e-05 | 0.00e+00 | 7.23e-05 | 7.23e-05 |
| c-3-Methyl-2-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 5.32e-05 | 0.00e+00 | 5.32e-05 | 5.32e-05 |
| Vinyl Acetate | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.53e-05 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.53e-05 | 3.53e-05 |
| Bromochloromethane | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 3.44e-05 | 0.00e+00 | 3.44e-05 | 3.44e-05 |

# Table 5-17
# (Continued)

| Compound | Section 1/9 | | | Section 2/8 | | Section 3/4 | | Section 6/7 | Landfill Gas Production Rates (b) | Total Landfill Gas Air Emissions © |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Passive Vents | Gas Collection System[a] | Surface | Passive Vents | Surface | Passive Vents | Surface | | |
| 4-Methyl-1-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.01e-05 | 0.00e+00 | 8.91e-06 | 0.00e+00 | 2.90e-05 | 2.90e-05 |
| Neopentane | 0.00e+00 | 0.00e+00 | 1.05e-03 | 0.00e+00 | 9.20e-06 | 0.00e+00 | 1.79e-05 | 0.00e+00 | 1.08e-03 | 2.71e-05 |
| Butyraldehyde | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 2.37e-05 | 0.00e+00 | 2.37e-05 | 2.37e-05 |
| Chloroprene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 1.82e-05 | 0.00e+00 | 1.82e-05 | 1.82e-05 |
| 2,4-4-Trimethyl-2-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| 1-Propanol | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| 1-Nonene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Vinyl Bromide | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| p-Chlorotoluene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Methylcyclopentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Acrylonitrile | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Dibromochloromethane | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Bromoform | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Freon 23 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| Acetaldehyde | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |
| t-4-Methyl-2-Pentene | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 | 0.00e+00 |

NM = Not Measured
[a]Emissions from gas collection system include emissions from landfill gas condensate produced by landfill gas collection system.
[b]Total landfill gas production is the sum of emissions measured at the soil surface and passive vents and landfill gas collection system.
[c]Total landfill gas air emissions only include emissions from soil surface and passive vents. Emissions from landfill gas collection system are incinerated.

# Table 5-18
# Comparison of Average Landfill Gas Composition to Values Reported in The Literature

| Compound | Gas Collection System (ppm) | Range Reported in Literature (a) (ppm) |
|---|---|---|
| TNMHC | 438 | 234 - 14,294 |
| Ethane | 223 | 0 - 1780 |
| Limonene | 35.4 | 470 |
| Toluene | 14.6 | 0.2 - 758 |
| Propane | 13.0 | 0 - 86.5 |
| a-Pinene | 7.85 | 446 |
| Acetone | 6.09 | 0 - 32 |
| p-Xylene + m-Xylene | 5.97 | 0 - 70.9 |
| Ethylbenzene | 4.71 | 0.15 - 428 |
| n-Butane | 3.80 | 0 - 32 |
| n-Nonane | 3.57 | 167 |
| o-Dichlorobenzene | 2.17 | 0 |
| o-Xylene | 2.17 | 3.7 - 664 |
| Dichlorodifluoromethane | 1.27 | 0 - 43.99 |
| Chlorobenzene | 1.15 | 0 - 10 |
| n-Octane | 0.99 | 152 |
| n-Pentane | 0.97 | 0 - 46.53 |
| Benzene | 0.93 | 0 - 52.2 |
| n-Hexane | 0.92 | 0 - 25 |
| Trichlorofluoromethane | 0.69 | 0 - 11.9 |
| Methylene Chloride | 0.55 | 0 - 174 |
| Methylcyclohexane | 0.52 | 2.4 - 197 |
| 1,1-Dichloroethane | 0.34 | 0 - 19.5 |
| Vinyl Chloride | 0.27 | 0 - 48.1 |
| Trichloroethene | 0.24 | 0.01 - 34 |
| Chloromethane | 0.23 | 0 - 10.22 |
| 1,1,1-Trichloroethane | 0.19 | 0 - 9 |
| Chloroethane | 0.13 | 0 - 9.2 |
| 1,1,2,2-Tetrachloroethane | 0.03 | 0 - 2.35 |
| Dichlorofluoromethane | ND | 0 - 26.11 |
| Dibromochloromethane | ND | 0 |
| Carbon Tetrachloride | ND | 0 - 68.3 |
| Bromodichloromethane | ND | 0 - 7.85 |
| Bromomethane | ND | 0 |

## Table 5-18
## (Continued)

| Compound | Gas Collection System (ppm) | Range Reported in Literature (a) (ppm) |
|---|---|---|
| Bromoform | ND | 0 |
| Chloroform | ND | 0 - 1.56 |
| Chlorodifluoromethane | ND | 0 - 12.58 |
| c-1,3-Dichloropropene | ND | 0 |
| 2-Butanone | ND | 129 |
| 1,2-Dibromoethane | ND | 0 |
| 1,1,2-Trichloroethane | ND | 0 - 0.1 |
| 1-Butanol | ND | 100 |
| Acrylonitrile | ND | 0 - 7.4 |
| 1,2-Dichloropropane | ND | 0 - 1.8 |
| 1,2-Dichloroethane | ND | 0 - 30.1 |

ND = Not detected

[a] Values reported in "Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Guidelines," March 1991.

# Table 5-19
## Emission Factors Based on Flux Chamber Measurements

| Compound | Emission Factor (g/sec-kg of MSW) |
|---|---|
| 1,1,1-Trichloroethane | 1.33e-11 |
| 1,1,2,2-Tetrachloroethane | 1.20e-11 |
| 1,1,2-Trichloroethane | 4.23e-14 |
| 1,1-Dichloroethane | 1.55e-11 |
| 1,1-Dichloroethylene | 2.81e-12 |
| 1,2,3-Trimethylbenzene | 3.01e-10 |
| 1,2,4-Trichlorobenzene | 9.02e-11 |
| 1,2,4-Trimethylbenzene | 1.30e-09 |
| 1,2-Dibromoethane | 2.89e-14 |
| 1,2-Dichloroethane | 3.58e-14 |
| 1,2-Dichloropropane | 1.86e-13 |
| 1,3,5-Trimethylbenzene | 6.27e-10 |
| 1,3-Butadiene | 8.26e-14 |
| 1,4-Dioxane & 2,2,4-Trimethylpentane | 4.99e-11 |
| 1-Butanol & Cyclohexane | 0.00e+00 |
| 1-Decene | 0.00e+00 |
| 1-Heptene | 0.00e+00 |
| 1-Hexene | 3.97e-12 |
| 1-Methylcyclohexene | 5.52e-13 |
| 1-Nonene | 0.00e+00 |
| 1-Octene | 3.47e-11 |
| 1-Pentene | 2.04e-13 |
| 1-Propanol | 0.00e+00 |
| 1-Undecene | 1.41e-12 |
| 2,2,3-Trimethylpentane | 6.97e-12 |
| 2,2.5-Trimethylhexane | 6.02e-11 |
| 2,3.4-Trimethylpentane | 2.32e-11 |
| 2,3-Dimethylbutane | 2.82e-13 |
| 2,4,4-Trimethyl-1-Pentene | 0.00e+00 |
| 2,4-4-Trimethyl-2-Pentene | 0.00e+00 |
| 2,4-Dimethylpentane | 1.08e-11 |
| 2,5-Dimethylhexane | 9.56e-12 |
| 2-Butanone | 0.00e+00 |
| 2-Ethyl-1-Butene | 0.00e+00 |
| 2-Methyl-1-Butene | 3.09e-11 |
| 2-Methyl-1-Pentene | 0.00e+00 |
| 2-Methyl-2-Butene | 1.75e-11 |
| 2-Methyl-2-Pentene | 7.89e-14 |
| 2-Methylheptane | 0.00e+00 |

## Table 5-19
## (Continued)

| Compound | Emission Factor (g/sec-kg of MSW) |
|---|---|
| 3,5,5-Trimethylhexene | 0.00e+00 |
| 3-Methyl-1-Butene | 1.07e-11 |
| 3-Methylheptane | 3.08e-11 |
| 3-Methylhexane | 3.63e-11 |
| 3-Methylpentane | 1.22e-11 |
| 4-Methyl-1-Pentene | 0.00e+00 |
| 4-Nonene | 0.00e+00 |
| Acetaldehyde | 0.00e+00 |
| Acetone | 5.74e-11 |
| Acetylene | 4.68e-12 |
| Acrylonitrile | 0.00e+00 |
| Benzene | 5.26e-11 |
| Benzyl Chloride & m-Dichlorobenzene | 6.13e-10 |
| Bromochloromethane | 0.00e+00 |
| Bromodichloromethane | 6.37e-13 |
| Bromoform | 0.00e+00 |
| Bromomethane | 1.36e-14 |
| Butyraldehyde | 0.00e+00 |
| Carbon Dioxide | 2.65e-05 |
| Carbon Tetrachloride | 5.21e-14 |
| Chlorobenzene | 2.22e-10 |
| Chlorodifluoromethane | 1.00e-11 |
| Chloroethane | 4.34e-12 |
| Chloroform | 6.49e-14 |
| Chloromethane | 1.49e-12 |
| Chloroprene | 0.00e+00 |
| Cumene | 1.53e-10 |
| Cyclohexene | 0.00e+00 |
| Cyclopentane | 1.07e-11 |
| Cyclopentene | 0.00e+00 |
| Dibromochloromethane | 0.00e+00 |
| Dichlorodifluoromethane | 3.60e-10 |
| Dichlorofluoromethane | 8.73e-15 |
| Dichlorotoluene | 5.81e-13 |
| Diethyl Ether & 2-Propanol | 9.20e-12 |
| Ethane | 6.62e-09 |
| Ethanol & Acetonitrile | 1.34e-10 |
| Ethylbenzene | 1.16e-09 |
| Ethylene | 1.08e-12 |

## Table 5-19
## (Continued)

| Compound | Emission Factor (g/sec-kg of MSW) |
|---|---|
| Freon 113 | 1.11e-12 |
| Freon 114 | 0.00e+00 |
| Freon 23 | 0.00e+00 |
| Heptanal | 1.19e-15 |
| Hexachloro-1,3-Butadiene | 1.37e-10 |
| Hexanal | 5.42e-11 |
| Hydrogen Sulfide | 4.34e-10 |
| Indan | 0.00e+00 |
| Indene | 4.26e-12 |
| Isobutane | 7.12e-10 |
| Isobutene + 1-Butene | 4.91e-11 |
| Isobutylbenzene | 2.14e-10 |
| Isoheptane + 2,3-Dimethylpentane | 4.87e-11 |
| Isopentane | 1.44e-10 |
| Isoprene | 1.21e-11 |
| Limonene | 1.30e-09 |
| MTBE, Isohexane, & c-4-Methyl-2-Pentene | 1.51e-11 |
| Methane | 1.42e-05 |
| Methanol | 7.06e-13 |
| Methylcyclohexane | 3.95e-11 |
| Methylcyclopentane | 1.27e-11 |
| Methylcyclopentene | 0.00e+00 |
| Methylene Chloride | 1.15e-11 |
| Methylisobutylketone | 2.22e-13 |
| Naphthalene | 8.22e-11 |
| Neohexane | 7.81e-12 |
| Neopentane | 0.00e+00 |
| Nitrogen | 1.48e-05 |
| Oxygen | 3.56e-06 |
| Propane | 5.77e-10 |
| Propylene | 4.66e-12 |
| Styrene | 2.84e-10 |
| TNMHC | 4.91e-08 |
| Tetrachloroethylene | 4.37e-11 |
| Toluene | 1.22e-09 |
| Total Unidentified VOCs | 1.95e-08 |
| Trichloroethene | 9.18e-12 |
| Trichloroethylene | 7.11e-13 |
| Trichlorofluoromethane | 7.90e-11 |

## Table 5-19
## (Continued)

| Compound | Emission Factor (g/sec-kg of MSW) |
|---|---|
| Vinyl Acetate | 0.00e+00 |
| Vinyl Bromide | 0.00e+00 |
| Vinyl Chloride | 7.21e-11 |
| a-Pinene & Benzaldehyde | 1.13e-09 |
| b-Pinene | 4.07e-10 |
| c-1,2-Dichloroethylene | 2.82e-11 |
| c-1,3-Dichloropropene | 3.55e-14 |
| c-2-Butene | 7.77e-13 |
| c-2-Hexene | 0.00e+00 |
| c-2-Octene | 0.00e+00 |
| c-2-Pentene | 6.82e-14 |
| c-3-Heptene | 0.00e+00 |
| c-3-Hexene | 6.66e-14 |
| c-3-Methyl-2-Pentene | 0.00e+00 |
| m-Chlorotoluene | 0.00e+00 |
| m-Diethylbenzene | 3.56e-10 |
| m-Ethyltoluene | 5.40e-10 |
| n-Butane | 2.77e-10 |
| n-Butylbenzene | 3.47e-10 |
| n-Decane & p-Dichlorobenzene | 4.94e-09 |
| n-Heptane | 4.99e-11 |
| n-Hexane | 3.71e-11 |
| n-Nonane | 1.19e-09 |
| n-Octane | 1.27e-10 |
| n-Pentane | 3.96e-11 |
| n-Propylbenzene | 5.41e-10 |
| n-Undecane | 1.15e-09 |
| o-Chlorotoluene | 0.00e+00 |
| o-Dichlorobenzene | 5.24e-10 |
| o-Ethyltoluene | 9.88e-10 |
| o-Xylene | 5.52e-10 |
| p-Chlorotoluene | 0.00e+00 |
| p-Diethylbenzene | 7.84e-10 |
| p-Ethyltoluene | 5.56e-10 |
| p-Isopropyltoluene | 0.00e+00 |
| p/m-Xylene | 1.28e-09 |
| t-1,2-Dichloroethylene | 2.01e-14 |
| t-1,3-Dichloropropene | 8.52e-14 |
| t-2-Butene | 2.68e-12 |

## Table 5-19
## (Continued)

| Compound | Emission Factor (g/sec-kg of MSW) |
|---|---|
| t-2-Heptene | 0.00e+00 |
| t-2-Hexene | 4.04e-14 |
| t-2-Pentene | 2.98e-12 |
| t-3-Heptene | 0.00e+00 |
| t-4-Methyl-2-Pentene | 0.00e+00 |

# Table 5-20
# Comparison of Measured Landfill Gas Emissions to Various Emission Estimation Techniques

| Compound | Total Landfill Gas Production Rates | Emission Estimates Based On LFG Collection System (a) | Emission Estimates Based On Flux Chamber Emission Factors (b) |
|---|---|---|---|
| TNMHC | 4.14e+01 | 7.29e+01 | 3.49e+03 |
| Toluene | 1.10e+00 | 2.67e+00 | 8.67e+01 |
| p/m-Xylene | 7.59e-01 | 1.26e+00 | 9.10e+01 |
| Ethylbenzene | 7.00e-01 | 9.66e-01 | 8.25e+01 |
| 1,2,4-Trimethylbenzene & t-Butylbenzene | 6.29e-01 | 1.21e+00 | 9.24e+01 |
| n-Nonane | 5.81e-01 | 9.09e-01 | 8.46e+01 |
| Methylene Chloride | 3.09e-01 | 8.31e-02 | 8.18e-01 |
| o-Xylene | 2.98e-01 | 4.53e-01 | 3.92e+01 |
| 1,1-Dichloroethane | 2.25e-01 | 8.48e-02 | 1.10e+00 |
| Styrene | 2.59e-01 | 4.27e-01 | 2.02e+01 |
| Chlorobenzene | 1.88e-01 | 2.61e-01 | 1.58e+01 |
| Benzyl Chloride & m-Dichlorobenzene | 1.68e-01 | 4.89e-01 | 4.36e+01 |
| Vinyl Chloride | 5.39e-02 | 3.53e-02 | 5.13e+00 |
| Benzene | 5.97e-02 | 1.45e-01 | 3.74e+00 |
| 1,1,1-Trichloroethane | 4.85e-02 | 4.57e-02 | 9.46e-01 |
| c-1,2-Dichloroethylene | 5.18e-02 | 1.09e-01 | 2.01e+00 |
| 1,2,4-Trichlorobenzene | 5.02e-02 | 3.25e-01 | 6.41e+00 |
| Trichloroethene | 1.41e-02 | 6.47e-02 | 6.53e-01 |
| 1,1-Dichloroethylene | 6.24e-03 | 1.49e-02 | 2.00e-01 |
| 1,1,2,2-Tetrachloroethane | 4.03e-03 | 5.15e-03 | 8.53e-01 |

(a) Estimated emissions = (emissions from landfill gas collection system)*(total landfill mass/mass under influence of gas collection system)

(b)Estimated emissions = (flux chamber emission factors [g/sec-kg waste])*(total mass waste in landfill)

## 6.0 QUALITY CONTROL RESULTS

A comprehensive Quality Assurance/Quality Control (QA/QC) effort was tailored to meet the specific needs of this project and is detailed in the Quality Assurance Project Plan (QAPP) (Anderson, Burrow, and Eklund, 1995). The QA/QC effort was implemented to ensure that the data collected are of known and sufficient quality to meet the overall project objectives and to allow qualitative and quantitative characterization of the composition of the landfill gas. The control procedures included, but were not limited to, frequent and regular instrument calibrations, analysis of blanks and standards, independent systems audits of field activities and equipment and performance audits of laboratories, use of standard reference methods, data verification and quality assessment, and peer review of the data presentation and conclusions.

The primary objectives of the QA/QC effort were to control, assess, and document data quality. In order to accomplish these objectives, the QA/QC approach consisted of the following key elements:

- Definition of data quality objectives that reflect the overall technical objectives of the project;
- Design of a sampling, analytical, QA/QC, and data analysis system to meet these objectives;
- Evaluation of the performance of the measurement system; and
- Implementation of appropriate corrective actions if the performance of the measurement system did not meet specifications.

Achievement of these QA/QC objectives resulted in a set of well-documented and defensible measurement data whose quality satisfies the needs of the project. This section presents a discussion of data quality and any anomalies or limitations in the use of the data, based on results for QC analyses and QA audits.

### 6.1 Summary of Data Quality

Review of quality indicators suggests that the data reported are valid and reliable for their intended use. For any measurement effort, there exists a degree of uncertainty in the measurement result. Overall measurement precision and accuracy, which include uncertainty in analysis as well as uncertainty in sampling, were controlled and assessed by adherence to specifications for sample collection, analytical method performance, and analysis of control samples. Analytical bias was controlled by routine calibration of all measurement instrumentation. Potential bias due to blank effects and recovery efficiency was monitored by routine analysis of blank samples and laboratory control standards. Repeatability of measurement results was checked both within and between analytical batches by on-going analysis of calibration check standards and second source laboratory control standards, and by replicate analyses of standards and samples within a batch. Evaluation of measurement uncertainty as a function of site parameters, such as spatial and temporal variability, were an integral part of the test design, and are discussed in Section 5 of this report.

Overall, the data show a high degree of reliability. All sample handling, tracking, and hold time requirements were met. Documentation of sampling and analysis is thorough and supports the reported data. However, some anomalies or concerns should be noted when interpreting or using the data for decision-making.

Whereas blind audit sample analysis results indicated accurate measurements for most compounds for which recovery objectives were specified in the QAPP, a few exceptions were noted. These are delineated in Section 6.3.2.

Carbon dioxide measurements for Section 3/4 passive vent canister samples appear to be biased high, based on the fixed gas ratios and closure balance. On-site fixed gas measurements were also taken, both for all the vents and in-situ, so these results may be more representative and useful.

## 6.2 Results of Quality Control Measures

Results for the QC measures implemented for field and laboratory activities are discussed in this section. The field activities included equipment calibration checks and analysis of blank and duplicate QC samples. Analytical activities included equipment calibration checks and analysis of laboratory control samples, laboratory blanks, and matrix spike/matrix spike duplicates.

The QC data are summarized in this section. Because of the large number of compounds analyzed, results for representative compounds are presented in most cases to illustrate analytical performance. Measurement uncertainties were normal for the types of samples and analytes, with different species exhibiting different behaviors in the measurement systems, as would be expected. Based on analyst experience and quality control data, the prominent types of uncertainties or anomalies in the measurement processes are discussed.

### 6.2.1 Field Quality Control

Measurements conducted on site included determination of landfill gas ($CH_4$, $CO_2$ , and $O_2$), flow rate, hydrogen sulfide, and mercury. Quality control measures associated with analyses included daily calibrations of the analytical instruments, replicate measurements, and analysis of blanks. A on-site technical systems audit was also conducted during sampling activities. Results of the audit are summarized in Section 6.3. The audit report is presented in Appendix O.

Mercury analyses were performed using a Jerome 431-X Gold Film Mercury Analyzer that is certified by the supplier against units traceable to National Institutes of Standards and Technology (NIST). Hydrogen sulfide analyses were performed using a Jerome 631-X Gold Film Hydrogen Sulfide Analyzer, also traceable to NIST calibration standards. A GeoGroup Model GA90 Landfill Gas Analyzer was used for on-site determinations of methane, carbon dioxide, and oxygen.

Results for analysis of calibration check samples showed on-going control of the measurement processes. The calibration of each analyzer was checked daily over a range of instrument responses. The calibration checks were documented in field notebooks. Blank sample analyses showed no evidence of systematic contamination. The mercury analyzer, which is calibrated at the factory against NIST traceable standards, is checked by generating a mercury-in-air sample, the concentration of which is dependent on the temperature of the calibration cell. There was some variation in generating the calibration check standard because of difficulty in holding a constant temperature in the drafty environment of the on-site trailer while conducting the calibration check, but the variation was random, with no evidence of significant bias in the instrument calibration. The mercury analyzer calibration data are presented in Table 6-1 (All tables appear at the end of the section).

The procedures for determination of mercury in samples from the landfill gas collection system and individual landfill gas extraction wells had to be modified in the field because of unexpectedly high levels of mercury. Instead of collecting the mercury on gold dosimeters, as described in the Sampling Plan, an alternate analysis scheme had to be developed in the field. The method that was used is described in detail in Section 3 of this document. Basically, the Jerome mercury calibration system was adapted to analyze the field samples. During the development of this method in the field, high levels of $H_2S$ were introduced into the analyzer from the sample sources.

The Jerome analyzer uses a gold film technique to quantitate the concentration of mercury in the samples. This technique is also sensitive to $H_2S$ (the Jerome $H_2S$ analyzer uses the same technique to quantitate $H_2S$) and uses an acid gas scrubber to remove $H_2S$ prior to analysis. Since high levels of $H_2S$ were introduced into the analyzer from the landfill collection header and gas extraction well samples, the scrubber may have been saturated with $H_2S$ and, therefore, the mercury data may have been affected. Note: the mercury samples collected from passive vents would not be affected by $H_2S$ interference because during desorption of mercury from the dosimeter, $H_2S$ is converted to $SO_2$, which is not on interferant. To determine if this occurred, a series of $H_2S$ standards were introduced into the mercury analyzer and the analyzer response was recorded. The technique used to introduce the $H_2S$ standards was the same as that used to measure the mercury concentrations from the landfill gas header and individual extraction wells. $H_2S$ standards with concentrations between 0 and 100 ppm $H_2S$ were injected into the analyzer to determine instrument response. The instrument response versus $H_2S$ concentration is shown in Table 6-2.

The results show an increase in false positive mercury responses with increasing hydrogen sulfide concentration, but only up to 2 ng mercury in the presence of 100 ppm hydrogen sulfide for a 1ml injection volume.

Most of the landfill gas collection header and extraction well samples had $H_2S$ concentrations of approximately 60-70 ppm. Therefore, the results show, assuming an average $H_2S$ concentration of 70 ppm, that the potential instrument bias for a typical sample may have been in the range of 1 ng mercury. The check results indicate that the capacity of the acid gas scrubber decreased relatively slowly, so the actual $H_2S$ interference for the field samples would have been negligible and almost certainly no higher than the data presented above. The mercury analyzer response ranged from 1 to 14 ng for gas collection header samples and from 6 to 8 ng for gas extraction well samples. Therefore, it is possible that the lowest measured mercury concentrations were artifacts of $H_2S$ interference. The vast majority of the measured mercury values, however, were well above this threshold, so the overall relative impact of $H_2S$ interference on mercury determinations was small.

The vane anemometers used for on-site flow rate determinations were calibrated by Davis Instruments Calibration Laboratory. Multipoint calibrations were performed at the Radian Field Support Laboratory for the rotameters. The anemometers and rotameter calibrations were checked before and after use in the sampling campaign.

Duplicate Measurements

Duplicate samples were collected and analyzed for $H_2S$ and mercury to assess the repeatability of results for samples collected at the same time and place. Duplicate analysis of individual samples was also conducted for $H_2S$ determinations to monitor and assess analytical imprecision. Duplicate analyses cannot be performed on mercury dosimeters because the entire sample is consumed during analysis. A detailed examination of the sources of measurement variability is discussed in Section 5, including temporal and spatial components of variability.

Replicate measurement were taken for each Tedlar bag sample analyzed on-site for mercury and hydrogen sulfide. The precision of the individual measurements was evaluated for the mid to high-range samples collected at the gas plant headers and extraction wells. The precision estimates are summarized below and indicate the observed variation of replicate determinations on individual samples. The confidence in the reported average value for each sample increases in proportion to the square root of the number of determinations; in this case, three to six readings per sample were taken with three being typical. The standard error in the reported average value for each sample is thus less than 10% for the mercury determinations, and less than 5% for $H_2S$.

| | Hg | $H_2S$ |
|---|---|---|
| Range | 1-7 ppm | 10-100 ppm |
| Std. Dev. | 0.4 ppm | 4.0 ppm |
| CV | 16% | 5% |
| SE | 9% | 3% |

Standard error (SE) is calculated as the %CV divided by the square root of the number of results used to calculate the average. The data indicate good precision for these measurements.

The average relative percent difference (RPD) between duplicate sample results for field measurements at the gas collection system and passive vents are summarized in Table 6-3. These RPDs are based only on duplicate field sample results which were reported above the detection limits. These results show good repeatability. The only relatively high RPD values were for oxygen at the gas collection plant, but the oxygen values were very near the instrument detection limit (0.5%), so the RPD value is reasonable. The RPD for duplicate samples for mercury in the passive vents was about 30 percent. RPD values were quite low for $H_2S$ in passive vents, less than 3 percent at an average concentration of about 50 ppm. At the much lower concentration measured in the flux chambers (0.017 ppm $H_2S$), the RPD is greater (18%), but still indicating good repeatability.

It is characteristic of most measurement systems that relative imprecision, such as RPD, increases with lower concentrations, while the absolute deviation, expressed in terms of the measurement concentration, tends to approach a constant value.

### 6.2.2 Analytical Quality Control

Results for instrument calibration checks and analysis of QC samples, including laboratory control samples (LCS), laboratory blanks, duplicates, matrix spikes (MS), and surrogate spike samples are discussed in this section. These samples served the dual purpose of controlling and assessing measurement data quality. The QC data indicate that, therefore, no significant problems with measurement data, that the data has a high degree of reliability, that QC measures were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error, and, most importantly, that the project objectives and specifications were met.

Each type of QC data is discussed with respect to the following parameter groups:

1) Volatile organic compounds (VOCs) by gas chromatography with multiple detectors (GC/MD);

2) Fixed gas by thermal conductivity detector (TCD); and

3) VOCs by gas chromatography with mass spectroscopy (GC/MS).

As appropriate, results of data obtained for each landfill sample source (surface flux chambers, passive vents, gas collection system, soils, seeps, and condensates) are presented within each parameter group.

#### 6.2.2.1 GC/MD Analyses

<u>Instrument Calibration Checks</u>

Instrument calibration check results are used as an indicator of analytical process control. The flame ionization detector (FID) and electrolytic conductivity detector (ELCD) calibrations were checked using vendor-certified standards for both systems used to analyze the VOC samples (low-level samples from the flux chambers and high-level samples from the passive vents and the gas collection system).

Results for the daily calibration checks of the FID indicated that the initial calibration curves were current and reliable, the system was in control during analysis, and acceptance criteria specified in the QAPP were satisfied. Most ELCD daily calibration checks were acceptable; exceptions were methylene chloride (21 of 23 passed), 1,2-dichloroethane (22 of 23 passed), and trichloroethene (22 of 23 passed). Though the individual checks were outside the calibration acceptance criteria (50-150%), the average for each analyte was within the criteria, indicating that overall instrument performance was not affected and that the criteria specified by the QAPP were satisfied. Calibration check results associated with $C_2C_3$ analysis also indicated acceptable instrumentation performance.

A four-point calibration curve, analyzed twice a year, is generated by use of the primary calibration standards referenced in Section 7.0 of the QAPP. A daily calibration check standard was analyzed prior to analysis of project samples. Samples were diluted in order to bring the fixed gas concentrations down to the instrument calibration range.

Results for the daily calibration checks of the thermal conductivity detector (TCD) system for analysis of fixed gases collected from the passive vents designated for full characterization indicated that the instrument performance did not change during sample analysis. All fixed gas calibration checks were within the QAPP-specified acceptance criteria. The lack of a high standard during the early part of analysis and additional canister dilutions appear to have resulted in a positive bias in the $CO_2$ results. The apparent systematic bias associated with $CO_2$ calibration primarily affects the data from the vents sampled in Section 3/4 of the landfill. A sum and ratio of fixed gases ($CH_4$, $CO_2$, $O_2$, $N_2$) for the Section 3/4 analyses also indicate a bias in the $CO_2$ measurements. The on-site fixed gas analysis results for $CO_2$ measurements provide a more complete and accurate analysis for these parameters.

Laboratory Control Samples

Laboratory control samples (LCS), prepared from using second-source standards (i.e., standards obtained from a different manufacturer than the one supplying standards used for calibration), are used to measure analyte recovery in the absence of actual sample matrix effects. One LCS or LCS duplicate pair was analyzed for each analytical batch to demonstrate that the analytical system was in control. The LCS target analyte lists, as shown in Tables 6-4 through 6-8, are based on second-source standard cocktails used by the laboratory to monitor and control method performance and verify the reliability of the calibration mixtures. Not all compounds are checked against second-source standards, although mid-point calibration checks are performed every analytical batch for all calibrated compounds.

The majority of the LCS recoveries associated with the FID flux chamber measurements were within the accuracy acceptance criteria for GC/MD analyses. Three of the 30 recoveries for ethylbenzene and two of the 30 recoveries for p-& m-xylene were outside the acceptance criteria; however, the average recoveries for both of these analytes were within the criteria, and, therefore, systematic bias is not indicated.

All 30 recoveries for styrene were outside the acceptance criteria; the average recovery was 41.8%. Fourteen of 17 styrene calibration checks were within acceptable limits and an independent performance evaluation sample recovery for styrene was 138%. No definite trend for the accuracy of styrene results can be determined from this data, but the styrene data clearly show a greater degree of measurement uncertainty.

The majority of the LCS recoveries associated with the ELCD were within the specified accuracy acceptance criteria. Eight of the 34 recoveries for cis-1,3-dichloropropene and five of the 34 recoveries for 1,1,2,2-tetrachloroethane were outside the acceptance criteria; the average recoveries for both of these analytes were within the criteria. Summaries of LCS recoveries for the flux chamber systems are presented in Tables 6-4 and 6-5.

All of the LCS recoveries associated with the FID passive vent measurements were within the specified accuracy acceptance criteria of 70-130% or 50-150% recovery.

The majority of the LCS recoveries associated with the ELCD were within the specified accuracy acceptance criteria with the exception of chloromethane/freon 114 and methylene chloride. Three of the 44 recoveries for these analytes were outside the 50-150% accuracy acceptance criteria; however, the average recoveries for both analytes (60% and 70%, respectively) were within the criteria, indicating that systems were in analytical control. Summaries of LCS recovery results for the passive vent and gas collection system measurements systems are presented in Tables 6-6 and 6-7.

All LCS recoveries associated with the TCD system for analysis of fixed gases were within the specified 70-130% accuracy acceptance criteria, indicating that the system was in analytical control. A summary of recovery results is presented in Table 6-8.

Blank Samples

Laboratory blanks are used to detect effects inherent in preparation and analytical procedures, including reagents, glassware, and instrument noise. One method blank, composed of humidified nitrogen, was analyzed in the same manner as a sample for each analytical batch to monitor and assess potential contamination.

The majority of the laboratory blank results associated with the FID were within the criteria specified by the QAPP or less than the target analyte reporting limits. Six of the 17 blanks were outside the acceptance criteria for 1-hexene (0.3 ppbV); the range of 1-hexene detected was 0.38 -1.67 ppbV, with an average of 0.73 ppbV. Benzene, toluene, n-decane + p-dichlorobenzene, and n-hexane were detected at levels outside the acceptance criteria in one of the 17 blanks; the average for each analyte was within the criteria.

None of the target analytes were detected above the acceptance criteria specified by the QAPP in blanks associated with the ELCD for flux chamber measurements. These results indicate that field data were not measurably affected by laboratory contamination or instrument noise. Method blank results associated with flux chamber samples are summarized in Tables 6-9 and 6-10.

None of the target analytes were detected above the acceptance criteria specified by the QAPP in laboratory blanks associated with the passive vent measurement system. These results indicate that sample data were not measurably affected by laboratory contamination or instrument noise. No target analytes were detected in blanks associated with the ELCD. FID laboratory blank results associated with passive vent sample are summarized in Table 6-11.

Field blanks were collected for flux chamber samples. Results for analytes detected in the field blanks are summarized in Table 6-12. These results point to no significant blank contamination, except for ethanol/acetonitrile and diethylether/2-

propanol. The high levels of these 2 sets of coeluting compounds, which are used in the manufacturer's cleaning process, are indicators of a faulty canister. This is a characteristic contamination pattern that was not observed in any other canisters. Even low levels of these compounds may be suspect, however.

None of the target analytes were detected above the acceptance criteria specified by the QAPP in blanks associated with the TCD analysis of fixed gases. These results in indicate that sample data were not measurably affected by laboratory contamination or instrument noise. Method blank results are summarized in Table 6-13.

Duplicate Samples

Results obtained from analysis of duplicate samples are used to assess sampling and analytical variability (precision). A detailed discussion of the source of emission variability is presented in Section 5. A summary of duplicate sample results for a selected list of prominent VOCs is presented in Table 6-14. These results indicate good overall measurement repeatability. As shown in Table 6-14, the RPDs exceed the 30% objective for a small number of compounds. The average concentration in these compounds was low in most cases, so the impact on the absolute concentration variability is small.

#### 6.2.2.2 GC/MS Analyses

Gas chromatography with mass spectroscopy was used as a confirmation tool for identification of volatile organic compounds in canister samples quantitated by GC/MD. GC/MS Method 8240 was used to determine volatile organic compounds in soil, seep water, and liquid condensate from the gas collection system according to EPA SW-846 Method 8240.

Quality control activities associated with GC/MS analyses included initial multipoint calibration, daily mass spectrometer tuning and calibration verification, and analysis of blanks, laboratory control samples, matrix spikes, and surrogate spikes.

Method 8240 analyses of solid and liquid samples met all method specifications.

LCS results for the GC/MS confirmational analyses associated with analysis of the high-level canister samples show positive recovery bias, in the range of 100-200 percent recovery for most compounds. However, as a tool for qualitative confirmation of species identification, the impact of positive bias is not such a concern as the inability to detect or recovery an analyte. LCS results associated with the analysis of low-level canister samples showed average results closer to or less than 100% of these, only benzyl chloride results were poor, averaging 50% recovery with a standard deviation of 50%. Although identification is not suspect, the quantitative results for benzyl chloride should be considered highly variable or semi-quantitative. Laboratory control sample results for GC/MS analyses are summarized in Table 6-15.

Blank Samples

Method 8240 (solids and liquids) blank sample results are summarized in Table 6-16 for those compounds in which the analyte was detected in the blank. A relatively small number of contaminants were detected, mostly the very light, highly volatile species that are not uncommon laboratory contaminants or which can easily cross-contaminate through air. These results show acetone as the only significant contaminant, with persistent concentrations near 30 µg/L.

For the canister samples, tetrachloroethylene, toluene, and xylenes were detected as contaminants in the blanks, probably due to ambient levels at the site. The amounts detected in the flux chamber field blanks were similar for both GC/MS and GC/MD analyses. Although helium was used as the sweep gas for the flux chamber blank samples, small amounts of nitrogen (5-6%) and oxygen (1-2%) were measured in all three field blanks, indicating some in-leakage of ambient air and consequently, some low-level VOC contamination. The same effect would not be expected for regular flux chamber samples, because the chamber is inserted into the soil. The amount of VOC contamination measured in the blanks was small compared to that measured in regular samples, so the impact should not be significant.

Matrix Spiked Samples

Duplicate matrix spiked samples were analyzed with each batch of liquid and soil samples analyzed by Method 8240. The samples were spiked with the standard 8240 matrix spike compound mixture to assess general method effectiveness in the sample matrix. (Matrix spikes were not analyzed with canister samples.) Results for the matrix spiked sample analyses indicate effective recoveries for the spiked compounds. Average recoveries were within ±5 percent of the spiked amount for the soil and slurry samples, and within ± 30 percent for the liquid condensate and water samples.

Precision estimates, expressed in terms of the average relative percent difference between duplicate matrix spike recoveries, were within 5 percent RPD for the solids and within 20 percent RPD for the liquids. Recovery of toluene was outside the method recovery limits in one out of eight spiked sample analyses of liquid samples. Recoveries were within the objectives for all other spiked sample analyses. Matrix spike recoveries for Method 8240 analyses are summarized in Table 6-17.

Every sample analyzed by GC/MS Method 8240 was also spiked with the suite of surrogate compounds (1,4-bromofluorobenzene, 1,2-dichloroethane-d4, and toluene-d8) as specified in the method to monitor method performance. Recoveries for the surrogate spike compounds are presented with each sample result in the laboratory reports. The surrogate recovery data show a stable measurement system with good recovery efficiency in each type of sample matrix.

Duplicate Samples

Duplicate samples were collected to assess imprecision in the total process of collecting and analyzing a sample from a single location and time. Sources of variability in the emission estimates are discussed in more detail in Section 5. Precision estimates based on duplicate sample analysis results are summarized in Table 6-18 for GC/MS analyses.

## 6.3 Results of QA Audits

An on-site Technical Systems Audit of field activities and a Laboratory Performance Audit of Radian's volatile organic compound (VOC) analytical laboratory were conducted to assess the progress and success of the monitoring effort in achieving the project data quality objectives. These audits were conducted by members of Radian's Quality Assurance staff who were not involved in the sampling or data processing activities. Summaries of the audits follow and copies of the Technical Systems Audit Report and the Performance Audit data are attached as Appendix O.

### 6.3.1 Technical Systems Audit

A Technical Systems Audit of the sampling and field analysis portions of the Fresh Kills Landfill Gas Emissions Study was conducted July 6-7, 1995. The conclusion drawn from this audit was that all quality control aspects of the sampling and field analysis tasks at the landfill were being conducted in accordance with the requirements of the Quality Assurance Project Plan/Sampling Plan.

Two minor concerns were identified related to documentation issues. Recommendations for resolution of these issues were discussed with the sampling team at the time of the audit and each concern was addressed/resolved while on-site. An accuracy check of the hydrogen sulfide analyzers was conducted using an independent standard; results of the check were within audit expectations. No further corrective action or follow-up was required, and the audit was closed.

Note: Minor concerns are typically based upon observed inconsistencies in procedures or other activities that normally do not directly impact data collection, analysis, or validity.

### 6.3.2 Performance Evaluation Audit

Performance audit samples for VOC and fixed gas analyses were prepared using standards that were independent of the calibration standards used for sample analysis. The samples were prepared in humidified matrices contained in stainless steel canisters from the lot used for collection of samples at the landfill. A total of three audit samples were prepared. Audit sample # 950801-01 consisted of low ppb-m range VOCs to simulate anticipated flux chamber measurement data. Audit sample # 950719-03 contained VOCs in the low-ppm range and was prepared in a landfill gas matrix of methane and carbon dioxide at volume-percent levels somewhat less than the levels recorded at the passive vents. Audit sample # 950719-04 contained alkanes and aromatics in the low-ppm range and was prepared in the landfill gas matrix at the maximum levels found in surveys of the passive vents.

Most of the audit sample results were within the recovery ranges specified in the QAPP. There were a significant number of compounds for which accuracy specifications were not given. In these cases, the audit information is simply reported with a calculated analytical recovery.

The potential problems identified from the audit samples are as follows:

Sample # 950801-01

- Ethane recovery was 31% at a theoretical concentration of 40.0 ppbV; the expected recovery range is 70-130%;

- 1,1,2,2-Tetrachloroethane recovery was 1075% at theoretical concentration of 1.2 ppbV; the expected recovery range is 50-150%;

- o-Xylene recovery was 400% at a theoretical concentration of 0.6 ppbV; the expected recovery range is 50-150%;

- Ethanol + acetonitrile (coeluting pair) were not detected at a theoretical concentration of 16.5 ppbV (False Negative);

- Methanol was not detected at a theoretical concentration of 33.7 ppbV (False Negative) and

- trans-2-Pentene was reported as present at a concentration of 4.0 ppbV (False Positive).

Data users should be aware that ethane, 1,1,2,2-tetrachloroethane, and o-xylene measurement data at concentrations similar to those in this audit sample have the potential to be biased high or low by the amounts shown. The results for ethanol + acetonitrile and methanol were not unexpected because of the well documented difficulty in sampling and analyzing polar compounds using stainless steel canisters. Results for trans-2-pentene at low ppbV levels have the potential to be reported when they are not present in the field samples.

Sample # 950719-03

- Styrene was reported as present at a concentration of 6.0 ppmV (False Positive); and
- o-Xylene was not detected at a theoretical concentration of 3.3 ppmV (False Negative).

The laboratory reviewed the styrene and o-xylene results for sample # 950719-03 and found that the peaks for these two compounds were misidentified because they are positioned closely together in the retention time library for the analytical system. No styrene was present in the audit sample. An amended report was produced with the corrected identifications and quantitations and the result was a recovery of o-xylene at 73%. Data users should be aware that the potential exists for this problem to occur in field measurement data.

Sample #950719-04

- Recovery of propane at 4.6 ppm was high, with a reported value of 14.6 ppm, or 317% recovery.

- All other recoveries for sample #950719-04 were within 70-130%.

Data users should be aware that propane measurement data for passive vent samples may have a bias at low-ppm concentrations.

## Table 6-1
## Jerome Model 431XD Mercury Analyzer Calibration Data

| Date | Time | Mercury Temp (°F) | Input Range | Analyzer Response | % Difference from Boundary of Range |
|---|---|---|---|---|---|
| 6/28/95 | 17:22 | 19.0 | .118-.159 | .112 | -5.0 |
| 6/29/95 | 10:35 | 22.0 | .151-.204 | .164 | In range |
| 6/30/95 | 10:08 | 23.8 | .164-.222 | .160 | -2.4 |
| 6/30/95 | -- | -- | 0 | 0.0 | -- |
| 7/01/95 | 8:24 | 21.6 | .138-.187 | .154 | In range |
| 7/03/95 | 10:05 | 20.6 | .129-.174 | .120 | -7.0 |
| 7/03/95 | -- | -- | 0 | 0.0 | -- |
| 7/05/95 | 9:30 | 23.8 | .164-.222 | .204 | In range |
| 7/05/95 | -- | -- | 0 | 0.0 | -- |
| 7/06/95 | 10:20 | 23.0 | .164-.222 | .141 | -14.0 |
| 7/06/95 | -- | -- | 0 | 0.0 | -- |
| 7/07/95 | 12:35 | 22.0 | .151-.204 | .137 | -9.3 |
| 7/08/95 | 8:00 | -- | 0 | 0.0 | -- |
| 7/08/95 | 8:10 | 20.0 | .129-.174 | .123 | -4.7 |
| 7/08/95 | 11:15 | 22 | .151-.204 | .140 | -7.3 |
| 7/10/95 | 9:10 | -- | 0 | 0.0 | -- |
| 7/10/95 | 9:15 | 21 | .138-.187 | .142 | In range |
| 7/11/95 | 9:40 | -- | 0 | 0.0 | -- |
| 7/11/95 | 9:45 | 22 | .151-.204 | .137 | -9.3 |
| 7/12/95 | 10:50 | -- | 0 | 0.0 | -- |
| 7/12/95 | 11:00 | 22 | .151-.204 | .124 | -17.9 |

Analyzer Serial Number: 03123 Operators: Gary Hall, Randy Stephens

## Table 6-2
## Summary of Results for $H_2S$ Interference Tests on Jerome Hg Analyzer

| Input Concentration (ppm $H_2S$) | Analyzer Response (ng/ml Hg) |
|---|---|
| 0 | 0 |
| 5.97 | 0 |
| 27.6 | 0.42 |
| 50 | 0.62 |
| 100 | 1.9 |

| To Convert | To | Multiply By |
|---|---|---|
| $\frac{ng}{mL}$ Hg | $\frac{\mu g}{m^3}$ Hg | 1000 |
| $\frac{\mu g}{m^3}$ Hg | ppmv Hg | 0.00012 |
| ppmv Hg | g Hg/sec | 0.00014 x VFR ($m^3$/min) |

As an example, the potential Hg bias based on interference from 50 ppm $H_2S$ in a gas collection system header with a nominal flow rate of 100 $m^3$/min, would be:

$$0.62 \ \frac{ng}{mL} \ Hg \times 1000 \times 0.00012 \times 0.00014 \times 100 = 0.001 \ g/sec \ Hg.$$

*VFR = volumetric flow rate.

## Table 6-3
## Summary of Precision Estimates for On-site Analyses of Field Duplicate Samples

| Sample Type | Compound | Units | Mean Sample Conc. | RPD |
|---|---|---|---|---|
| Flux Chamber | Hydrogen Sulfide | ppm | 0.017 | 18.2 |
| Gas Collection System | Carbon Dioxide | % | 39.1 | 2.6 |
| Gas Collection System | Methane | % | 56.0 | 2.1 |
| Gas Collection System | Oxygen | % | 0.50 | 80.0 |
| Passive Vent | Hydrogen Sulfide | ppm | 47.9 | 2.3 |
| Passive Vent | Mercury | ppm | 1.0 | 28.9 |

# Table 6-4
## FID LCS Recovery Results for GC/MD VOC Analysis of Flux Chamber Samples

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| Benzene | 96-117 | 101 | 6.28 | 6.19 | 70-130 | 0/30 |
| Toluene | 84-119 | 93.6 | 9.22 | 9.85 | 70-130 | 0/30 |
| Chlorobenzene | 83-110 | 90.7 | 7.17 | 7.91 | 50-150 | 0/30 |
| Ethylbenzene | 87-156 | 107 | 16.4 | 15.3 | 50-150 | 3/30 |
| p- & m-Xylene | 65-112 | 79.8 | 11.1 | 13.9 | 70-130 | 2/30 |
| Styrene | 30-61 | 41.8 | 7.08 | 16.9 | 70-130 | 30/30 |
| o-Xylene | 78-119 | 92.4 | 9.47 | 10.3 | 50-150 | 0/30 |
| p-Ethyltoluene | 61-104 | 75.2 | 9.85 | 13.1 | 50-150 | 0/30 |
| 1,3,5-Trimethylbenzene | 58-102 | 69.5 | 11.3 | 16.2 | 50-150 | 0/30 |
| 1,2,4-Trimethylbenzene | 52-92 | 64.1 | 9.44 | 14.7 | 50-150 | 0/30 |
| Benzyl chloride + m-DCB | 54-117 | 70.6 | 20.1 | 28.5 | 50-150 | 0/30 |
| p-Dichlorobenzene | 70-110 | 87.7 | 9.76 | 11.1 | 50-150 | 0/30 |
| o-Dichlorobenzene | 65-107 | 78.5 | 9.59 | 12.2 | 50-150 | 0/30 |
| 1,2,4-Trichlorobenzene | 42-91 | 56.6 | 11.4 | 56.6 | 25-150 | 0/30 |
| 1,3-Hexachlorobutadiene | 50-83 | 62.9 | 8.08 | 62.9 | 25-175 | 0/30 |

## Table 6-5
## ELCD LCS Recovery Results for GC/MD VOC Analysis of Flux Chamber Samples

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| Dichlorodifluoromethane | 68-119 | 95.2 | 12.7 | 13.3 | 50-150 | 0/34 |
| Chloromethane | 74-124 | 102 | 14.4 | 14.1 | 50-150 | 0/34 |
| Vinyl chloride | 60-115 | 87.6 | 13.8 | 15.8 | 50-150 | 0/34 |
| Bromomethane | 68-124 | 98.0 | 13.9 | 14.1 | 10-175 | 0/34 |
| Chloroethane | 72-113 | 97.1 | 9.98 | 10.3 | 50-150 | 0/34 |
| Trichlorofluoromethane | 73-116 | 96.3 | 10.8 | 11.3 | 50-150 | 0/34 |
| 1,1-Dichloroethylene | 62-107 | 88.8 | 10.8 | 12.1 | 50-150 | 0/34 |
| Methylene chloride | 67-119 | 98.4 | 14.1 | 14.4 | 50-150 | 0/34 |
| Freon 113 | 69-115 | 96.7 | 10.6 | 11.0 | 50-150 | 0/34 |
| 1,1-Dichloroethane | 62-118 | 97.0 | 13.6 | 14.0 | 50-150 | 0/34 |
| cis-1,2-Dichloroethylene | 62-108 | 89.9 | 13.7 | 15.3 | 50-150 | 0/34 |
| Chloroform | 59-113 | 90.4 | 13.5 | 15.0 | 50-150 | 0/34 |
| 1,1,1-Trichloroethane | 71-113 | 97.9 | 12.4 | 12.6 | 50-150 | 0/34 |
| Carbon tetrachloride | 70-117 | 95.3 | 12.9 | 13.5 | 50-150 | 0/34 |
| 1,2-Dichloroethane | 58-116 | 95.4 | 15.4 | 16.1 | 50-150 | 0/34 |
| Trichloroethylene | 59-104 | 90.1 | 10.9 | 12.1 | 50-150 | 0/34 |
| 1,2-Dichloropropane | 67-114 | 95.6 | 12.5 | 13.1 | 50-150 | 0/34 |
| cis-1,3-Dichloropropene | 85-172 | 137 | 19.1 | 14.0 | 50-150 | 8/34 |

# Table 6-5
## (Continued)

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| trans-1,3-Dichloropropene | 70-112 | 95.1 | 9.83 | 10.3 | 25-175 | 0/34 |
| 1,1,2-Trichloroethane | 81-137 | 111 | 14.3 | 12.9 | 50-150 | 0/34 |
| 1,2-Dibromoethane | 54-99 | 80.9 | 13.7 | 16.9 | 50-150 | 0/34 |
| Tetrachloroethylene | 66-120 | 99.1 | 13.0 | 13.5 | 50-150 | 0/34 |
| 1,1,2,2-Tetrachloroethane | 99-193 | 133 | 21.7 | 16.5 | 50-150 | 5/34 |

# Table 6-6
## FID LCS Recovery Results for GC/MD VOC Analysis of Passive Vents and Gas Collection System Samples

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| Benzene | 95 to 106 | 101 | 2.4 | 2.4 | 70-130 | 0/46 |
| Toluene | 97 to 107 | 103 | 3.0 | 2.9 | 70-130 | 0/46 |
| m-Xylene/p-Xylene | 73 to 102 | 94 | 6.4 | 6.8 | 70-130 | 0/46 |
| o-Xylene | 73 to 85 | 79 | 2.4 | 3.0 | 50-150 | 0/46 |
| n-Decane/p-Dichlorobenzene | 53 to 73 | 62 | 4.7 | 7.7 | 50-150 | 0/46 |

# Table 6-7
## ELCD LCS Recovery Results for GC/MD VOC Analysis of Passive Vents and Gas Collection System Samples

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| Chloromethane/Halocarbon 114 | 44 to 70 | 60 | 9.35 | 16.0 | 50-150 | 3/46 |
| Vinyl chloride | 87 to 113 | 103 | 5.38 | 5.20 | 50-150 | 0/46 |
| Methylene chloride | 46 to 117 | 70 | 16.7 | 24.0 | 50-150 | 3/46 |
| Chloroform | 99 to 119 | 109 | 5.20 | 4.80 | 50-150 | 0/46 |
| Carbon tetrachloride | 95 to 113 | 105 | 4.40 | 4.20 | 50-150 | 0/46 |
| 1,2-Dichloroethane | 74 to 129 | 112 | 13.0 | 12.0 | 50-150 | 0/46 |
| Trichloroethene | 84 to 121 | 109 | 7.06 | 6.50 | 50-150 | 0/46 |
| Tetrachloroethene | 51 to 105 | 98 | 8.00 | 8.20 | 50-150 | 0/46 |

## Table 6-8
## LCS Recovery Results for TCD System for Fixed Gas Analysis of Passive Vents Samples

| Analyte | Results (% Recovery) | | | | Acceptance Criteria (% Recovery) | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range | Average | SD | %CV | | |
| Oxygen | 92 to 109 | 97 | 3.87 | 4.00 | 70-130 | 0/36 |
| Nitrogen | 83 to 104 | 99 | 3.39 | 3.40 | 70-130 | 0/36 |
| Methane | 98 to 118 | 103 | 3.65 | 3.60 | 70-130 | 0/36 |
| Carbon Monoxide | 88 to 97 | 95 | 1.85 | 2.00 | 70-130 | 0/36 |
| Carbon Dioxide | 84 to 120 | 98 | 10.0 | 10.0 | 70-130 | 0/36 |

Note: Based on mass balance closures and ratios of fixed gases, the carbon dioxide values in the field samples appear to be high. Therefore, on-site analytical results were used.

## Table 6-9
## FID Laboratory Blank Results for GC/MD VOC Analysis of Flux Chamber Samples

| Analyte | Results | | | | Acceptance Criteria | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range (PPBV) | Average | SD | %CV | | |
| Benzene | 0.22-0.57 | 0.33 | 0.21 | 61.5 | 0.4 | 1/17 |
| Toluene | 0.22-0.96 | 0.41 | 0.31 | 74.6 | 0.5 | 1/17 |
| Ethylbenzene | 0.31 | 0.31 | 0 | 0 | 0.7 | 0/17 |
| p-Xylene + m-xylene | 0.20-0.44 | 0.28 | 0.09 | 32.4 | 1.0 | 0/17 |
| n-octane | 0.23-0.69 | 0.36 | 0.22 | 62.2 | 0.8 | 0/17 |
| n-Decane + p-dichlorobenzene | 0.23-1.07 | 0.41 | 0.33 | 79.6 | 0.7 | 1/17 |
| n-propylbenzene | 0.25 | 0.25 | 0 | 0 | 0.7 | 0/17 |
| Benzyl chloride + m-dichlorobenzene | 0.31 | 0.31 | 0 | 0 | 0.6 | 0/17 |
| o-Dichlorobenzene | 0.20-0.50 | 0.35 | 0.21 | 60.6 | 0.7 | 0/17 |
| n-Hexane | 0.27-0.39 | 0.33 | 0.085 | 25.7 | 0.3 | 1/17 |
| 1-Hexene | 0.38-1.67 | 0.73 | 0.48 | 66.3 | 0.3 | 6/17 |

## Table 6-10
## ELCD Laboratory Blank Results for GC/MD VOC Analysis of Flux Chamber Samples

| Analyte | Results | | | | Acceptance Criteria | Number Outside Criteria/Total |
|---|---|---|---|---|---|---|
| | Range (PPBV) | Average | SD | %CV | | |
| 1,3-Hexachlorobutadiene | 0.003-0.096 | 0.059 | 0.04 | 68.6 | 1.0 | 0/20 |
| Trichloroethylene | 0.03 | 0.03 | 0 | 0 | 0.1 | 0/20 |
| Tetrachloroethylene | 0.03 | 0.03 | 0 | 0 | 0.1 | 0/20 |
| 1,1,2,2-Tetrachloroethane | 0.03 | 0.03 | 0 | 0 | 0.5 | 0/20 |
| Chloromethane + Freon 114 | 0.03 | 0.03 | 0 | 0 | 0.2 | 0/20 |
| Freon 113 | 0.03 | 0.03 | 0 | 0 | 0.4 | 0/20 |
| Methylene chloride | 0.03 | 0.03 | 0 | 0 | 0.2 | 0/20 |
| Chloroprene | 0.03 | 0.03 | 0 | 0 | 0.2 | 0/20 |
| Dibromochloromethane | 0.20 | 0.20 | 0 | 0 | 0.7 | 0/20 |
| cis-1,2-Dichloroethylene | 0.04-0.05 | 0.045 | 0.007 | 15.7 | 0.2 | 0/20 |
| 1,1,1-Trichloroethane | 0.02-0.04 | 0.03 | 0.014 | 47.1 | 0.2 | 0/20 |

# Table 6-11
# FID Laboratory Blanks Results for GC/MD VOC Analysis of Passive Vents and Gas Collection System Samples

| Analyte | Results (ppbV) | | Acceptance Criteria (ppbV) | Number Outside Criteria/Total |
|---|---|---|---|---|
| | Range | Average | | |
| Ethane | ND to 999 | 423 | NS | 0/23 |
| Chlorobenzene | ND to 67 | 39 | 250 | 0/23 |
| 2-Methyl-2-butene | ND to 29 | 29 | NS | 0/23 |
| m-Xylene/p-Xylene | ND to 23 | 20 | 250 | 0/23 |
| o-Xylene | ND to 15 | 15 | 250 | 0/23 |
| Styrene | ND to 49 | 39 | 250 | 0/23 |
| p-Ethyltoluene | ND to 18 | 18 | 250 | 0/23 |
| 1,3,5-Trimethylbenzene | ND to 27 | 27 | 250 | 0/23 |
| 1,2,4-Trimethylbenzene | ND to 81 | 32 | 250 | 0/23 |
| Benzyl chloride/m-dichlorobenzene | ND to 84 | 34 | 250 | 0/23 |
| n-Decane/p-Dichlorobenzene | ND to 71 | 29 | 250 | 0/23 |
| o-Dichlorobenzene | ND to 66 | 38 | 250 | 0/23 |
| n-Undecane | ND to 34 | 24 | NS | 0/23 |
| Limonene | ND to 16 | 15 | NS | 0/23 |
| 1,2,4-Trichlorobenzene | ND to 67 | 41 | 250 | 0/23 |
| Naphthalene | ND to 28 | 28 | NS | 0/23 |
| TNMHC | 67 to 669 | 281 | NS | 0/23 |

NS = Not Specified.
*Average detected value.

# Table 6-12
# Summary of Flux Chamber Field Blank Results for VOCs by GC/MD Analysis

| Compound | Result | Units | Detection Limit |
|---|---|---|---|
| 1,1,1-Trichloroethane | 0.05 | ppbV | 0.05 |
| 1,1-Dichloroethane | 0.04 | ppbV | 0.1 |
| 1,2,3-Trimethylbenzene | 0.08 | ppbV | 0.08 |
| 1,2,3-Trimethylbenzene | 0.09 | ppbV | 0.08 |
| 1,2,3-Trimethylbenzene | 0.99 | ppbV | 0.08 |
| 1,2,4-Trimethylbenzene | 0.1 | ppbV | 0.1 |
| 1,2,4-Trimethylbenzene | 0.3 | ppbV | 0.1 |
| 1,3,5-Trimethylbenzene | 0.19 | ppbV | 0.08 |
| 1-Butanol & Cyclohexane | 0.1 | ppbV | 0.35 |
| 3-Methylhexane | 0.20 | ppbV | 0.12 |
| Acetone (+) | 2.30 | ppbV | 0.62 |
| Acetone (+) | 12.6 | ppbV | 0.62 |
| Benzene | 0.09 | ppbV | 0.35 |
| Cyclopentane | 13.3 | ppbV | 0.14 |
| Dichlorodifluoromethane | 0.03 | ppbV | 0.1 |
| Dichlorodifluoromethane | 0.2 | ppbV | 0.1 |
| Diethyl Ether & 2-Propanol | 104 | ppbV | 0.47 |
| Ethane | 1 | ppbV | 2.46 |
| Ethane | 2.1 | ppbV | 2.46 |
| Ethane | 9.4 | ppbV | 2.46 |
| Ethanol & Acetonitrile | 747 | ppbV | 0.3 |
| Ethylbenzene | 0.2 | ppbV | 0.13 |
| Ethylbenzene | 0.4 | ppbV | 0.13 |
| Ethylene | 0.5 | ppbV | 0.95 |

**Table 6-12**
**(Continued)**

| Compound | Result | Units | Detection Limit |
|---|---|---|---|
| Ethylene | 0.6 | ppbV | 0.95 |
| Ethylene | 1.4 | ppbV | 0.95 |
| Hexanal | 0.19 | ppbV | 0.12 |
| Indene | 0.19 | ppbV | 0.11 |
| Indene | 0.29 | ppbV | 0.11 |
| Isobutane | 0.2 | ppbV | 0.54 |
| Isobutane | 3.3 | ppbV | 0.54 |
| Isobutane | 11.5 | ppbV | 0.54 |
| Isobutene + 1-Butene | 4.3 | ppbV | 0.25 |
| Isobutene + 1-Butene | 5.9 | ppbV | 0.25 |
| Isobutene + 1-Butene | 21.9 | ppbV | 0.25 |
| Isopentane | 1.4 | ppbV | 0.5 |
| Isopentane | 4.7 | ppbV | 0.5 |
| Limonene | 1 | ppbV | 0.08 |
| Limonene | 2.4 | ppbV | 0.08 |
| Limonene | 3.8 | ppbV | 0.08 |
| Methanol (+) | 4.8 | ppbV | 1.53 |
| Methylene Chloride | 0.04 | ppbV | 0.07 |
| Methylene Chloride | 0.08 | ppbV | 0.07 |
| Methylene Chloride | 0.09 | ppbV | 0.07 |
| Nitrogen | 5.36 | % | 0.001 |
| Nitrogen | 5.37 | % | 0.001 |
| Nitrogen | 6.7 | % | 0.001 |
| Oxygen | 1.45 | % | 0.001 |
| Oxygen | 1.58 | % | 0.001 |

## Table 6-12
## (Continued)

| Compound | Result | Units | Detection Limit |
|---|---|---|---|
| Oxygen | 1.92 | % | 0.001 |
| Propane | 0.3 | ppbV | 0.97 |
| Propane | 0.69 | ppbV | 0.97 |
| Propane | 9.69 | ppbV | 0.97 |
| Propylene | 0.99 | ppbV | 0.43 |
| Propylene | 1.101 | ppbV | 0.43 |
| Propylene | 11.49 | ppbV | 0.43 |
| Styrene | 0.104 | ppbV | 0.09 |
| Styrene | 0.304 | ppbV | 0.09 |
| Tetrachloroethylene | 0.3 | ppbV | 0.03 |
| Tetrachloroethylene | 0.5 | ppbV | 0.03 |
| Tetrachloroethylene | 1.5 | ppbV | 0.03 |
| Toluene | 0.79 | ppbV | 0.4 |
| Toluene | 2.19 | ppbV | 0.4 |
| Toluene | 2.49 | ppbV | 0.4 |
| Total Unidentified Halogenated VOCs | 0.09 | ppbV | 0.03 |
| Total Unidentified Halogenated VOCs | 0.20 | ppbV | 0.03 |
| Total Unidentified Halogenated VOCs | 0.50 | ppbV | 0.03 |
| Total Unidentified VOCs | 12.4 | ppbV | 1.1 |
| Total Unidentified VOCs | 13.2 | ppbV | 1.1 |
| Total Unidentified VOCs | 13.3 | ppbV | 1.1 |
| Trichloroethylene + BCM | 0.03 | ppbV | 0.02 |
| Trichloroethylene + BCM | 0.04 | ppbV | 0.02 |
| Trichloroethylene + BCM | 0.1 | ppbV | 0.02 |
| Trichlorofluoromethane | 0.03 | ppbV | 0.06 |

## Table 6-12
## (Continued)

| Compound | Result | Units | Detection Limit |
|---|---|---|---|
| a-Pinene & Benzaldehyde | 0.08 | ppbV | 0.07 |
| c-1,2-Dichloroethylene | 0.06 | ppbV | 0.04 |
| c-1,2-Dichloroethylene | 0.2 | ppbV | 0.04 |
| c-2-Butene | 0.1 | ppbV | 0.18 |
| c-2-Butene | 0.2 | ppbV | 0.18 |
| c-2-Butene | 0.7 | ppbV | 0.18 |
| m-Diethylbenzene | 0.07 | ppbV | 0.06 |
| m-Ethyltoluene | 0.08 | ppbV | 0.11 |
| m-Ethyltoluene | 0.19 | ppbV | 0.11 |
| n-Butane | 0.3 | ppbV | 0.74 |
| n-Butane | 0.4 | ppbV | 0.74 |
| n-Butane | 0.8 | ppbV | 0.74 |
| n-Butylbenzene | 0.1 | ppbV | 0.08 |
| n-Butylbenzene | 0.2 | ppbV | 0.08 |
| n-Decane & p-Dichlorobenzene | 0.8 | ppbV | 0.09 |
| n-Decane & p-Dichlorobenzene | 1.6 | ppbV | 0.09 |
| n-Decane & p-Dichlorobenzene | 1.90 | ppbV | 0.09 |
| n-Heptane | 0.09 | ppbV | 0.13 |
| n-Hexane | 0.19 | ppbV | 0.26 |
| n-Nonane | 0.19 | ppbV | 0.08 |
| n-Nonane | 0.39 | ppbV | 0.08 |
| n-Nonane | 0.50 | ppbV | 0.08 |
| n-Octane | 0.2 | ppbV | 0.1 |
| n-Octane | 0.4 | ppbV | 0.1 |
| n-Octane | 0.90 | ppbV | 0.1 |

## Table 6-12
## (Continued)

| Compound | Result | Units | Detection Limit |
|---|---|---|---|
| n-Pentane | 0.2 | ppbV | 0.32 |
| n-Propylbenzene | 0.09 | ppbV | 0.08 |
| n-Propylbenzene | 0.19 | ppbV | 0.08 |
| o-Ethyltoluene | 0.09 | ppbV | 0.09 |
| o-Ethyltoluene | 0.19 | ppbV | 0.09 |
| o-Xylene | 0.10 | ppbV | 0.1 |
| o-Xylene | 0.2 | ppbV | 0.1 |
| o-Xylene | 0.3 | ppbV | 0.1 |
| p-Ethyltoluene | 0.09 | ppbV | 0.08 |
| p-Ethyltoluene | 0.19 | ppbV | 0.08 |
| p-Xylene + m-Xylene | 0.4 | ppbV | 0.19 |
| p-Xylene + m-Xylene | 0.8 | ppbV | 0.19 |
| t-2-Butene | 0.2 | ppbV | 0.2 |
| t-2-Butene | 1 | ppbV | 0.2 |

# Table 6-13
## Laboratory Blanks Results for TCD System for Fixed Gas Analysis of Passive Vents Samples

| Analyte | Results (%) | | Acceptance Criteria (%) | Number Outside Criteria |
|---|---|---|---|---|
| | Range | Average | | |
| Oxygen | 0 to 0.32 | 0.10 | <0.5 | 0/19 |
| Nitrogen | 0 to 1.5 | 0.61 | <2.0 | 0/19 |
| Methane | 0 to 0.30 | 0.028 | <1.0 | 0/19 |
| Carbon Monoxide | 0 to 0 | 0 | <1.0 | 0/19 |
| Carbon Dioxide | 0 to 0.88 | 0.15 | <1.0 | 0/21 |

**Table 6-14**
**Summary of Duplicate Sample Results for VOC Analyses by GC/MD**

| Compound | No. of Pairs w/ Compound Detected | Avg Conc (ppmv) | Avg RPD |
|---|---|---|---|
| **Extraction Wells** | | | |
| 1,1-Dichloroethane | 1 | 1.2 | 30.6 |
| 1,1-Dichloroethylene | 1 | 0.1 | 26.0 |
| 1,1,1-Trichloroethane | 1 | 0.4 | 26.1 |
| 1,1,2,2-Tetrachloroethane | 1 | 0.0 | 0.3 |
| 1,2,4-Trichlorobenzene | 3 | 0.9 | 18.6 |
| Benzene | 3 | 0.9 | 17.7 |
| Benzyl Chloride & m-Dichlorobenzene | 3 | 1.3 | 57.5 |
| c-1,2-Dichloroethylene | 3 | 0.3 | 21.3 |
| Chlorobenzene | 3 | 1.1 | 16.9 |
| Ethylbenzene | 3 | 4.7 | 23.7 |
| Isobutane | 3 | 5.9 | 23.9 |
| Isopentane | 2 | 1.8 | 20.0 |
| Methylene Chloride | 1 | 1.0 | 10.9 |
| n-Butane | 3 | 2.5 | 20.5 |
| n-Decane & p-Dichlorobenzene | 3 | 14.3 | 20.1 |
| n-Nonane | 3 | 3.5 | 17.5 |
| n-Undecane | 3 | 6.4 | 22.2 |
| o-Xylene | 3 | 3.0 | 51.2 |
| p-Xylene + m-Xylene | 3 | 5.8 | 18.7 |
| Styrene | 3 | 2.2 | 18.8 |
| Tetrachloroethylene | 3 | 0.7 | 29.0 |
| Toluene | 3 | 15.5 | 18.3 |
| Trichloroethene | 1 | 0.5 | 26.7 |
| Vinyl Chloride | 1 | 0.3 | 17.7 |

## Table 6-14
## (Continued)

| Compound | No. of Pairs w/ Compound Detected | Avg Conc (ppmv) | Avg RPD |
|---|---|---|---|
| **Flux Chambers** | | | |
| 1,1-Dichloroethane | 1 | 7.5 | 9.5 |
| 1,1-Dichloroethylene | 1 | 0.3 | 85.9 |
| 1,1,1-Trichloroethane | 1 | 1.6 | 69.5 |
| 1,1,2,2-Tetrachloroethane | 1 | NA | NA |
| 1,2,4-Trichlorobenzene | 3 | 0.0 | 15.0 |
| Benzene | 3 | 2.0 | 35.9 |
| Benzyl Chloride & m-Dichlorobenzene | 3 | 0.4 | 14.0 |
| c-1,2-Dichloroethylene | 3 | 2.0 | 85.0 |
| Chlorobenzene | 3 | 18.5 | 8.8 |
| Ethylbenzene | 3 | 5.8 | 23.2 |
| Isobutane | 3 | 67.5 | 40.1 |
| Isopentane | 2 | 39.1 | 72.9 |
| Methylene Chloride | 1 | 2.2 | 38.1 |
| n-Butane | 3 | 28.9 | 25.5 |
| n-Decane & p-Dichlorobenzene | 3 | 10.9 | 29.7 |
| n-Nonane | 3 | 2.9 | 17.0 |
| n-Undecane | 3 | 0.4 | 15.6 |
| o-Xylene | 3 | 5.7 | 15.8 |
| p-Xylene + m-Xylene | 3 | 4.0 | 17.7 |
| Styrene | 3 | 15.4 | 11.4 |
| Tetrachloroethylene | 3 | 4.5 | 69.7 |
| Toluene | 3 | 7.6 | 28.5 |
| Trichloroethene | 1 | 0.4 | 2.6 |
| Vinyl Chloride | 1 | 0.5 | 94.8 |

## Table 6-14
## (Continued)

| Compound | No. of Pairs w/ Compound Detected | Avg Conc (ppmv) | Avg RPD |
|---|---|---|---|
| **Passive Vents** | | | |
| 1,1-Dichloroethane | 7 | 0.3 | 9.6 |
| 1,1-Dichloroethylene | 2 | 0.0 | 41.7 |
| 1,1,1-Trichloroethane | 3 | 0.1 | 14.9 |
| 1,1,2,2-Tetrachloroethane | 7 | 0.1 | 13.6 |
| 1,2,4-Trichlorobenzene | 8 | 0.3 | 17.5 |
| Benzene | 8 | 0.6 | 5.6 |
| Benzyl Chloride & m-Dichlorobenzene | 8 | 2.4 | 52.0 |
| c-1,2-Dichloroethylene | 8 | 2.0 | 9.5 |
| Chlorobenzene | 9 | 2.1 | 4.4 |
| Ethylbenzene | 9 | 10.6 | 15.9 |
| Isobutane | 9 | 6.6 | 6.5 |
| Isopentane | 9 | 0.8 | 6.7 |
| Methylene Chloride | 4 | 0.4 | 6.2 |
| n-Butane | 9 | 3.0 | 4.9 |
| n-Decane & p-Dichlorobenzene | 9 | 16.6 | 53.6 |
| n-Nonane | 9 | 7.5 | 4.5 |
| n-Undecane | 8 | 4.1 | 9.8 |
| o-Xylene | 9 | 5.6 | 9.9 |
| p-Xylene + m-Xylene | 9 | 15.6 | 9.4 |
| Styrene | 9 | 2.6 | 6.9 |
| Tetrachloroethylene | 8 | 0.9 | 16.9 |
| Toluene | 9 | 21.9 | 2.4 |
| Trichloroethene | 8 | 0.3 | 10.4 |
| Vinyl Chloride | 8 | 3.0 | 15.0 |

## Table 6-15
## Summary of Laboratory Control Sample Results for GC/MS Analyses

| Analyte | No. of LCS | % Recovery Mean | Std Dev | Min | Max |
|---|---|---|---|---|---|
| **High-level VOC Canister GC/MS (ppm)** | | | | | |
| Benzene | 8 | 91 | 18.0 | 64 | 114 |
| Carbon tetrachloride | 8 | 102 | 17.2 | 77 | 125 |
| Chloroform | 8 | 146 | 30.1 | 100 | 179 |
| Chloromethane | 8 | 92 | 4.4 | 87 | 101 |
| p-Dichlorobenzene | 8 | 176 | 82.0 | 96 | 339 |
| 1,2-Dichloroethane | 8 | 151 | 30.9 | 109 | 189 |
| Methylene chloride | 8 | 104 | 15.1 | 80 | 123 |
| Tetrachloroethylene | 8 | 210 | 64.1 | 130 | 313 |
| Toluene | 8 | 164 | 41.4 | 119 | 226 |
| Trichloroethylene | 8 | 144 | 28.0 | 103 | 176 |
| Vinyl chloride | 8 | 102 | 6.6 | 96 | 114 |
| m/p-Xylene | 8 | 186 | 46.4 | 121 | 255 |
| o-Xylene | 8 | 166 | 39.2 | 108 | 228 |
| **Low-level VOC Canister GC/MS (ppb)** | | | | | |
| Benzene | 8 | 81 | 6.0 | 72 | 92 |
| Benzyl chloride | 8 | 49 | 50.2 | 1.5 | 106 |
| Bromomethane | 8 | 88 | 14.0 | 73 | 110 |
| Carbon tetrachloride | 8 | 81 | 15.4 | 54 | 94 |
| Chlorobenzene | 8 | 92 | 12.0 | 70 | 105 |
| Chloroethane | 8 | 84 | 20.6 | 63 | 113 |
| Chloroform | 8 | 98 | 21.5 | 63 | 126 |
| Chloromethane | 8 | 91 | 20.0 | 71 | 116 |
| 1,2-Cibromoethane | 8 | 94 | 12.8 | 72 | 111 |

**Table 6-15**
**(Continued)**

| Analyte | No. of LCS | % Recovery | | | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Min | Max |
| m-Dichlorobenzene | 8 | 77 | 16.7 | 53 | 99 |
| o-Dichlorobenzene | 8 | 73 | 16.9 | 48 | 97 |
| p-Dichlorobenzene | 8 | 71 | 15.9 | 48 | 93 |
| Dichlorodifluoromethane | 8 | 78 | 6.0 | 72 | 87 |
| 1,1-Dichloroethane | 8 | 84 | 16.1 | 68 | 104 |
| 1,2-Dichloroethane | 8 | 92 | 18.5 | 63 | 118 |
| 1,1-Dichloroethylene | 8 | 87 | 12.6 | 73 | 105 |
| c-1,2-Dichloroetheylene | 8 | 109 | 23.8 | 79 | 149 |
| 1,2-Dichloropropane | 8 | 74 | 9.5 | 64 | 91 |
| c-1,3-Dichloropropene | 8 | 161 | 57.2 | 107 | 271 |
| t-1,3-Dichloropropene | 8 | 130 | 45.4 | 75 | 187 |
| Ethylbenzene | 8 | 113 | 15.3 | 93 | 135 |
| p-Ethyltoluene | 8 | 81 | 13.3 | 64 | 101 |
| Freon 113 | 8 | 78 | 12.8 | 65 | 96 |
| Freon 114 | 8 | 81 | 9.9 | 71 | 97 |
| Hexachloro-1,3-butadiene | 8 | 30 | 14.5 | 14 | 59 |
| Methylene chloride | 8 | 86 | 18.0 | 68 | 110 |
| Styrene | 8 | 51 | 7.4 | 43 | 63 |
| 1,1,2,2-Tetrachlororethane | 8 | 157 | 34.2 | 115 | 216 |
| Tetrachloroethylene | 8 | 91 | 13.0 | 68 | 105 |
| Toluene | 8 | 121 | 40.7 | 71 | 183 |
| 1,2,3-Trichlorobenzene | 8 | 34 | 18.0 | 13 | 63 |
| 1,1,1-Trichloroethane | 8 | 88 | 19.0 | 57 | 111 |
| 1,1,2-Trichloroethane | 8 | 136 | 60.0 | 80 | 247 |
| Trichloroethylene | 8 | 76 | 6.1 | 66 | 86 |

## Table 6-15
## (Continued)

| Analyte | No. of LCS | % Recovery | | | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Min | Max |
| Trichlorofluoromethane | 8 | 76 | 6.5 | 68 | 86 |
| 1,2,4-Trichlorobenzene | 8 | 68 | 12.5 | 51 | 86 |
| 1,3,5-Trimethylbenzene | 8 | 74 | 14.7 | 56 | 96 |
| Vinly chloride | 8 | 86 | 18.6 | 65 | 111 |
| m/p-Xylene | 8 | 85 | 13.0 | 72 | 105 |
| o-Xylene | 8 | 90 | 15.8 | 73 | 117 |
| **VOCs in Liquid Samples by GC/MS Method 8240 (μg/L)** | | | | | |
| Acetone | 8 | 101 | 8.5 | 84 | 111 |
| Acrolein | 8 | 69 | 6.6 | 59 | 78 |
| Acrylonitrile | 8 | 103 | 6.2 | 93 | 112 |
| Benzene | 8 | 100 | 2.4 | 95 | 102 |
| Bromodichloromethane | 8 | 108 | 3.5 | 104 | 114 |
| Bromoform | 8 | 90 | 9.1 | 79 | 103 |
| Bromomethane | 8 | 83 | 2.1 | 81 | 87 |
| 2-Butanone | 8 | 113 | 9.6 | 103 | 132 |
| Carbon disulfide | 8 | 98 | 3.3 | 94 | 103 |
| Carbon tetrachloride | 8 | 120 | 5.5 | 111 | 126 |
| Chlorobenzene | 8 | 91 | 3.6 | 84 | 94 |
| Chloroethane | 8 | 85 | 3.2 | 81 | 89 |
| 2-Chloroethyl vinyl ether | 8 | 92 | 2.9 | 87 | 95 |
| Chloroform | 8 | 144 | 121.0 | 93 | 443 |
| Chloromethane | 8 | 84 | 3.4 | 80 | 88 |
| Dibromochloromethane | 8 | 89 | 3.9 | 83 | 93 |
| Dichlorodifluoromethane | 8 | 100 | 8.1 | 90 | 111 |
| 1,1-Dichloroethane | 8 | 99 | 3.5 | 92 | 103 |

## Table 6-15
## (Continued)

| Analyte | No. of LCS | % Recovery | | | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Min | Max |
| 1,2-Dichloroethane | 8 | 113 | 2.0 | 110 | 116 |
| 1,1-Dichloroethylene | 8 | 85 | 3.5 | 80 | 90 |
| t-1,2-Dichloroethylene | 8 | 100 | 2.5 | 96 | 103 |
| 1,2-Dichloropropane | 8 | 95 | 3.9 | 87 | 100 |
| c-1,3-Dichloropropene | 8 | 109 | 3.2 | 106 | 115 |
| t-1,3-Dichloropropene | 8 | 104 | 3.0 | 101 | 109 |
| Ethylbenzene | 8 | 96 | 2.0 | 93 | 98 |
| 2-Hexanone | 8 | 100 | 5.8 | 94 | 109 |
| 4-Methyl-2-pentanone (MIBK) | 8 | 109 | 6.6 | 98 | 119 |
| Methylene chloride | 8 | 76 | 3.5 | 72 | 81 |
| Styrene | 8 | 96 | 2.0 | 93 | 99 |
| 1,1,2,2-Tetrachloroethane | 8 | 91 | 4.2 | 86 | 97 |
| Tetrachloroethene | 8 | 89 | 4.5 | 82 | 96 |
| Toluene | 8 | 100 | 2.6 | 95 | 102 |
| 1,1,1-Trichloroethane | 8 | 116 | 3.6 | 112 | 121 |
| 1,1,2-Trichloroethane | 8 | 88 | 3.3 | 83 | 93 |
| Trichloroethylene | 8 | 92 | 4.2 | 83 | 96 |
| Trichlorofluoromethane | 8 | 91 | 3.7 | 85 | 96 |
| Vinyl acetate | 8 | 103 | 9.0 | 93 | 118 |
| Vinly chloride | 8 | 80 | 2.9 | 77 | 85 |
| m/p-Xylene | 8 | 100 | 1.9 | 97 | 102 |
| o-Xylene | 8 | 99 | 2.1 | 97 | 102 |
| **VOCs in Soils by GC/MS Method 8240 ($\mu$g/kg)** | | | | | |
| Acetone | 8 | 131 | 22.8 | 103 | 163 |
| Acrolein | 8 | 98 | 28.9 | 63 | 134 |

**Table 6-15**
**(Continued)**

| Analyte | No. of LCS | % Recovery | | | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Min | Max |
| Acrylonitrile | 8 | 102 | 5.4 | 93 | 109 |
| Benzene | 8 | 100 | 2.1 | 96 | 102 |
| Bromodichloromethane | 8 | 105 | 2.9 | 100 | 109 |
| Bromoform | 8 | 91 | 3.8 | 85 | 96 |
| Bromomethane | 8 | 90 | 7.7 | 78 | 102 |
| 2-Butanone | 8 | 104 | 7.1 | 95 | 119 |
| Carbon disulfide | 8 | 100 | 4.9 | 92 | 105 |
| Carbon tetrachloride | 8 | 107 | 12.2 | 96 | 126 |
| Chlorobenzene | 8 | 94 | 3.0 | 90 | 99 |
| Chloroethane | 8 | 84 | 4.8 | 76 | 89 |
| 2-Chloroethyl vinyl ether | 8 | 90 | 3.6 | 84 | 95 |
| Chloroform | 8 | 112 | 5.8 | 103 | 119 |
| Chloromethane | 8 | 84 | 5.8 | 78 | 94 |
| Dibromochloromethane | 8 | 91 | 2.0 | 88 | 94 |
| Dichlorodifluoromethane | 8 | 106 | 4.9 | 98 | 112 |
| 1,1-Dichloroethane | 8 | 100 | 4.7 | 91 | 104 |
| 1,2-Dichloroethane | 8 | 120 | 9.5 | 106 | 132 |
| 1,1-Dichloroethylene | 8 | 95 | 7.4 | 85 | 104 |
| t-1,2-Dichloroethylene | 8 | 102 | 3.8 | 96 | 107 |
| 1,2-Dichloropropane | 8 | 92 | 5.8 | 84 | 100 |
| c-1,3-Dichloropropene | 8 | 100 | 7.2 | 89 | 109 |
| t-1,3-Dichloropropene | 8 | 98 | 5.5 | 90 | 104 |
| Ethylbenzene | 8 | 97 | 3.7 | 92 | 102 |
| 2-Hexanone | 8 | 96 | 7.0 | 87 | 109 |
| 4-Methyl-2-pentanone (MIBK) | 8 | 99 | 7.2 | 88 | 108 |

## Table 6-15
## (Continued)

| Analyte | No. of LCS | % Recovery | | | |
|---|---|---|---|---|---|
| | | Mean | Std Dev | Min | Max |
| Methylene chloride | 8 | 81 | 3.9 | 72 | 84 |
| Styrene | 8 | 97 | 2.4 | 94 | 101 |
| 1,1,2,2-Tetrachloroethane | 8 | 94 | 3.7 | 86 | 98 |
| Tetrachloroethene | 8 | 96 | 5.0 | 90 | 104 |
| Toluene | 8 | 101 | 2.3 | 98 | 105 |
| 1,1,1-Trichloroethane | 8 | 119 | 7.8 | 104 | 125 |
| 1,1,2-Trichloroethane | 8 | 93 | 2.7 | 90 | 97 |
| Trichloroethylene | 8 | 95 | 2.4 | 91 | 98 |
| Trichlorofluoromethane | 8 | 100 | 6.6 | 96 | 116 |
| Vinyl acetate | 8 | 102 | 14.0 | 86 | 118 |
| Vinly chloride | 8 | 85 | 7.3 | 75 | 97 |
| m/p-Xylene | 8 | 101 | 3.9 | 95 | 106 |
| o-Xylene | 8 | 101 | 4.1 | 95 | 106 |

## Table 6-16
## Summary of Blank Sample Hits for GC/MS Analyses

| Sample Type | Section | Blank Type | Analysis Method | Compound | Result | Units | Detection Limit |
|---|---|---|---|---|---|---|---|
| Condensate | 1/9 | Trip Blank | SW8260A | 2-Butanone | 7.03 | ug/L | 1.6 |
| Condensate | 1/9 | Trip Blank | SW8260A | Acetone | 27.1 | ug/L | 2.87 |
| Condensate | 1/9 | Trip Blank | SW8260A | Dibromomethane | 0.573 | ug/L | 0.59 |
| Condensate | 1/9 | Trip Blank | SW8260A | Methylene Chloride | 0.829 | ug/L | 3.03 |
| Condensate | 1/9 | Trip Blank | SW8260A | Acetone | 21.6 | ug/L | 2.87 |
| Condensate | 1/9 | Trip Blank | SW8260A | Dibromomethane | 0.509 | ug/L | 0.59 |
| Condensate | 1/9 | Trip Blank | SW8260A | Methylene Chloride | 0.721 | ug/L | 3.03 |
| Condensate | 1/9 | Trip Blank | SW8260A | 2-Butanone | 4.27 | ug/L | 1.6 |
| Condensate | 1/9 | Trip Blank | SW8260A | Acetone | 21.7 | ug/L | 2.87 |
| Condensate | 1/9 | Trip Blank | SW8260A | Dibromomethane | 0.548 | ug/L | 0.59 |
| Condensate | 1/9 | Trip Blank | SW8260A | Methylene Chloride | 0.813 | ug/L | 3.03 |
| Flux Chamber | 6/7 | System blank | GC/MS | Dichlorodifluoromethane | 0.119 | ppbV | 0.0463 |
| Flux Chamber | 6/7 | System blank | GC/MS | Styrene | 0.34 | ppbV | 0.0556 |
| Flux Chamber | 6/7 | System blank | GC/MS | Tetrachloroethylene | 0.801 | ppbV | 0.112 |
| Flux Chamber | 6/7 | System blank | GC/MS | Tetrachloroethylene | 0.933 | ppbV | 0.112 |
| Flux Chamber | 6/7 | System blank | GC/MS | Toluene | 1.26 | ppbV | 0.0851 |
| Flux Chamber | 6/7 | System blank | GC/MS | Toluene | 1.43 | ppbV | 0.0851 |
| Flux Chamber | 6/7 | System blank | GC/MS | o-Dichlorobenzene | 0.46 | ppbV | 0.0854 |
| Flux Chamber | 6/7 | System blank | GC/MS | p-Xylene + m-Xylene | 0.275 | ppbV | 0.1 |
| Flux Chamber | 6/7 | System blank | GC/MS | p-Xylene + m-Xylene | 0.409 | ppbV | 0.1 |
| Soil | 1/9 | Trip Blank | SW8260A | 2-Butanone | 6.73 | ug/L | 1.6 |
| Soil | 1/9 | Trip Blank | SW8260A | Acetone | 27.6 | ug/L | 2.87 |
| Soil | 1/9 | Trip Blank | SW8260A | Dibromomethane | 0.355 | ug/L | 0.59 |
| Soil | 1/9 | Trip Blank | SW8260A | Methylene Chloride | 0.54 | ug/L | 3.03 |

# Table 6-17
## Summary of Matrix Spike Duplicate Analysis Results for GC/MS Method 8240 Analyses

| Analyte | No. of MS/MSD Pairs | % Recovery | | Acceptance Critera | Relative Percent Difference | | Acceptance Critera | No. Outside Criteria |
|---|---|---|---|---|---|---|---|---|
| | | Mean | Range | | Mean | Range | | |
| **Soil Samples** | | | | | | | | |
| Benzene | 3 | 102 | 97-108 | 67-141 | 1.2 | 0-3.0 | ≤15 | 0 |
| Chlorobenzene | 3 | 102 | 98-106 | 67-127 | 1.5 | 0-2.9 | ≤12 | 0 |
| 1,1-Dichloroethene | 3 | 100 | 98-106 | 31-172 | 2.2 | 0-7.8 | ≤61 | 0 |
| Toluene | 3 | 96 | 94-97 | 75-131 | 0.3 | 0-1.0 | ≤14 | 0 |
| Trichloroethene | 3 | 99 | 97-102 | 71-149 | 1.3 | 0-2.0 | ≤35 | 0 |
| **Liquid Samples** | | | | | | | | |
| Benzene | 4 | 108 | 97-145 | 37-151 | 11 | 2.9-28 | 53 | 0 |
| Chlorobenzene | 4 | 101 | 95-105 | 37-160 | 4.5 | 2.9-8.1 | 52 | 0 |
| 1,1-Dichloroethene | 4 | 87 | 78-92 | 62-118 | 11 | 2.3-23 | 133 | 0 |
| Toluene | 4 | 128 | 97-271 | 47-150 | 20 | 2.9-62 | 53 | 1 |
| Trichloroethene | 4 | 102 | 97-107 | 71-157 | 4.7 | 2.0-7.8 | 47 | 0 |

## Table 6-18
## Summary of Duplicate Sample Results for VOCs by GC/MS

| Compound | No. of Pairs w/ Compound Detected | Avg Conv (ppmv) | Avg RPD |
|---|---|---|---|
| **Flux Chambers** | | | |
| 1,1,1-Trichloroethane | 1 | 5.265 | 90.6 |
| 1,2,4-Trimethylbenzene | 1 | 0.449 | 34.7 |
| 1,4-Difluorobenzene | 2 | 2.075 | 1.1 |
| 2-Bromo-1,1,1-trifluoroethane | 2 | 1.73 | 34.5 |
| Dichlorodifluoromethane | 1 | 4.35 | 127.8 |
| Ethylbenzene | 1 | 0.16585 | 94.2 |
| Methylene Chloride | 1 | 2.11 | 28.4 |
| p-Xylene + m-Xylene | 1 | 0.2615 | 61.6 |
| Toluene | 1 | 0.621 | 6.8 |
| Trichloroethene | 1 | 0.443 | 54.2 |
| Trichlorofluoromethane | 1 | 1.205 | 55.6 |
| **Passive Vents** | | | |
| 1,2,4-Trimethylbenzene | 1 | 10.775 | 15.3 |
| 1,3,5-Trimethylbenzene | 1 | 4.645 | 18.7 |
| 1,4-Difluorobenzene | 1 | 0.42 | 2.9 |
| 2-Bromo-1,1,1-trifluoroethane | 1 | 0.4945 | 4.2 |
| Benzene | 1 | 0.7505 | 3.9 |
| Chlorobenzene | 1 | 0.265 | 13.6 |
| Dichlorodifluoromethane | 1 | 0.326 | 1.2 |
| Ethylbenzene | 1 | 18.15 | 8.3 |
| o-Dichlorobenzene | 1 | 0.1725 | 24.9 |
| o-Xylene | 1 | 9.87 | 10.7 |

## Table 6-18
## (Continued)

| Compound | No. of Pairs w/ Compound Detected | Avg Conv (ppmv) | Avg RPD |
|---|---|---|---|
| p-Dichlorobenzene | 1 | 1.705 | 32.3 |
| p-Ethyltoluene | 1 | 2.765 | 14.8 |
| p-Xylene + m-Xylene | 1 | 26.5 | 9.8 |
| Styrene | 1 | 0.424 | 15.1 |
| Toluene | 1 | 33 | 21.8 |
| Vinyl Chloride | 1 | 2.215 | 15.8 |

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